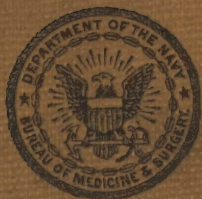


HOSPITAL CORPS
HANDBOOK
UNITED STATES NAVY
—
1923



14410630R



NLM 05101395 4

NATIONAL LIBRARY OF MEDICINE

SURGEON GENERAL'S OFFICE
LIBRARY.

Section -----

No. 113,
W. D. S. G. O.

No. 254411

3-513

LIBRARY
FEB 8 1924

SURGEON GENERAL'S
OFFICE

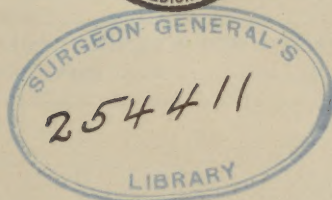
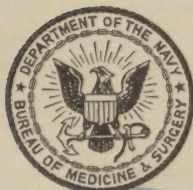
HOSPITAL CORPS HANDBOOK

UNITED STATES NAVY

1923



U.S.
THE BUREAU OF MEDICINE AND SURGERY
UNDER THE AUTHORITY OF
THE SECRETARY OF THE NAVY



WASHINGTON
GOVERNMENT PRINTING OFFICE

1923

VG

460

94582h

1923

BUREAU OF MEDICINE AND SURGERY,

NAVY DEPARTMENT,

Washington, D. C., May 1, 1923.

The Hospital Corps Handbook, United States Navy, 1923, is compiled from articles prepared by members of the Medical, Hospital, and Nurse Corps, and reviewed and revised by Lieuts. W. J. C. Agnew and W. W. Behlow, Medical Corps, and Chief Pharmacist N. L. Saunders, United States Navy. It is published for the instruction and guidance of members of the Medical Department of the United States Navy and for use at the Hospital Corps Training Schools.

E. R. STITT,

Surgeon General, U. S. Navy.

TABLE OF CONTENTS.

	Page.
FOREWORD -----	v
Chapter.	
1. HISTORY OF THE HOSPITAL CORPS-----	1
2. ANATOMY AND PHYSIOLOGY-----	5
3. FIRST AID AND MINOR SURGERY-----	57
(a) BANDAGING -----	98
(b) DENTAL FIRST AID-----	110
4. NURSING-----	115
(a) OPERATING ROOM AND SURGICAL TECHNIQUE-----	163
(b) ANÆSTHESIA-----	178
(c) PHYSIOTHERAPY -----	193
(d) FOODS AND DIETETICS-----	222
5. PREVENTIVE MEDICINE, HYGIENE AND SANITATION-----	237
(a) FIELD SANITATION-----	311
(b) VENEREAL DISEASES-----	324
(c) EMBALMING -----	347
6. CHEMISTRY -----	353
7. PHARMACY-----	383
8. MATERIA MEDICA -----	407
(a) DRUG ADDICTION-----	483
9. TOXICOLOGY -----	489
10. BACTERIOLOGY, BLOOD WORK, AND IMMUNITY-----	501
(a) ANIMAL PARASITES OF MAN-----	510
(b) URINALYSIS AND BLOOD CHEMISTRY-----	521
11. SPECIAL ACTIVITIES AND INFORMATION-----	525
(a) DUTY INDEPENDENT OF MEDICAL OFFICERS-----	525
(b) DUTY WITH SHIP'S LANDING FORCE AND ON SHORE PATROL-----	533
(c) DUTY WITH MARINE CORPS EXPEDITIONARY FORCES-----	539
(d) ROENTGENOLOGY-----	544
(e) CHEMICAL WARFARE-----	554
(f) DEATHS AND MEDICO-LEGAL MATTERS-----	563
(g) RECRUITING -----	575
12. ADMINISTRATION-----	579
(a) GENERAL PLAN, ARRANGEMENT AND MANAGEMENT OF NAVAL HOSPITALS-----	579
(b) ORGANIZATION, CLERICAL DUTIES AND PROCEDURES-----	582
(c) COMMISSARY WORK-----	650
INDEX-----	683

FOREWORD.

The Hospital Corps Handbook, United States Navy, 1923, replaces the familiar "Handy Book" and under its new title is a revised edition of that book.

Its object is to present in epitomized form certain important subjects and facts which will be of assistance to members of the Hospital Corps in the performance of their duties, and to serve as a reference book containing instructions relative to the duties of the Hospital Corps of the Navy.

Readers of the handbook should realize the importance of not depending *entirely* upon it for the information desired, and are urged to consult reference books obtainable, as a rule, from the library of any medical officer. Frequent reference should be made to the United States Navy Regulations, the Manual of the Medical Department, and the Bureau of Navigation Manual. The Naval Medical Bulletin and the Hospital Corps Quarterly contain valuable information and should be read carefully, paying particular attention to the copies of circular letters issued by the Bureau of Medicine and Surgery, and other bureaus, found in the last few pages of these publications.

Members of the Hospital Corps are cautioned against assuming too great responsibilities but they should feel at liberty and are urged to report any severe, unusual, or questionable case to a medical officer. Men on independent duty must, of course, assume responsibilities not ordinarily required in routine performance of duty, but should not neglect to report serious and doubtful cases to the first medical officer available.

Guarding the health of members of the naval service is just as important as the treatment and care of the sick, and for this reason hospital corpsmen on independent duty are advised not to forget to make such suggestions to their commanding officers as will tend to prevent outbreaks of epidemics or disease.

One of the most important things for members of the Hospital Corps to realize and to put into practice, is that all entries in health records, rough logs, smooth logs, etc., regarding the nature of sickness or injuries must be considered as confidential, and care should be taken not to permit the data contained in the health records from being disseminated or discussed among personnel other than members of the Medical and Hospital Corps. This should not be considered as prohibiting the consultation of hospital corpsmen on independent duty with their commanding officers on matters affecting the health of the personnel under their care.

Appreciation and thanks are herewith expressed for the courtesy of the following publishers in permitting the reproduction and use of certain illustrations in this book, William Wood & Co. for figures 5, 6, 9, 12, 14, 15, 19, 20, 26, 30, 32, 37, 52, 59, 140, 155, W. B. Saunders Co. for figures 54, 55, 66, 72, 97, 98, 99, 100, 101, 102, 104, 105, 106, 107, 141, Lea & Febiger for figures 7, 8, 13, 23, 24, 36, 38, 40, 44, 45, 46, 47, 48, 49, 50, 51, 65, 73, 75, 76, 77, 78, 80, 85, 86, 89, 94, 95, 96, 142, 146, 148, P. Blakiston's Son & Co. for figures 10, 11, 18, 53, 147, 149, 160, 162, 164, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, Paul B. Hoeber for figures 196, 197, 200, 201, and D. Appleton & Co. for figure 143, and for the assistance rendered by Francis Doty, chief pharmacist's mate, United States Navy, in preparing the index, L. L. Sargent, pharmacist's mate, first class, United States Navy, in typewriting the manuscript, and V. N. DeSantis, pharmacist's mate, third class, United States Navy, in preparing several of the sketches and illustrations.

CHAPTER I.

HISTORY OF THE HOSPITAL CORPS OF THE UNITED STATES NAVY.¹

Prior to 1898 the duties attendant upon the care of the sick and injured of the Naval Establishment were performed by certain individuals whose appointment or enlistment was provided for from time to time, under various designations and titles, by order of the Navy Department.

In the earliest days of the Navy, afloat, the care of the sick and injured devolved upon the surgeon and the surgeon's mate, with the assistance of such members of the crew as were detailed to help in emergencies.

An act of Congress, approved March 2, 1799, provided: "A convenient place shall be set apart for the sick and hurt men, to which they are to be removed * * * and some of the crew shall be appointed to attend them, and keep the place clean." The place assigned on board ships for the care of the sick, in accordance with the above act, was usually referred to as the "cockpit" and in later years it was designated as the "sickbay."

The "loblolly boy" was the title designating the man or boy first specifically detailed to assist in the care of the sick and injured. The name probably originated in the British Navy, as it appears in some of the early writings on that service. The first official use of the title in the United States Navy appears in the Naval Regulations published in 1814 where it is stated: "The loblolly boy is to serve the surgeon and surgeon's mate."

The following is quoted from United States Naval Regulations, 1818: "The surgeon shall be allowed a faithful attendant to issue, under his direction, all supplies and provisions and hospital stores, and to attend the preparation of nourishment for the sick.

"The surgeon's mates shall be particularly careful in directing the loblolly boy to keep the cockpit clean, and every article therein belonging to the Medical Department.

"The surgeon shall prescribe for casual cases on the gun deck every morning at 9 o'clock, due notice having been previously given by his loblolly boy by the ringing of a bell."

The loblolly boy was succeeded by a male "nurse" in accordance with a general order of the Navy Department of June 16, 1861, which stated: "There shall be allowed to each vessel commissioned for sea service, with a complement of less than two hundred, one nurse, and with two hundred and over two nurses * * * to be appointed by the surgeon and approved by the commander of the ship, and to be borne upon the ship's books for special service upon the sick."

About the year 1873 the title of "bayman" came into use, and this title was recognized officially in the United States Naval Regulations published in 1876, and it remained in effect until the organization of the Hospital Corps of the Navy in 1898.

Baymen were enlisted as landsmen for general service, and rated bayman by the commanding officer on the recommendation of the surgeon, or senior medical officer. The number was regulated by the complement of the vessel.

¹ Prepared by Chief Pharmacist J. Holden, United States Navy.

The record of the advent of surgeon's stewards in the Navy is more or less obscure, but this seems to have been shortly after the Bureau of Medicine and Surgery was established in 1842. The following is an extract from a letter found in the old files of the bureau under date of May 5, 1843.

"A circular is now under consideration to allow a surgeon's steward to all hospitals and vessels, without necessity to sign articles, but to be appointed."

The Medical Journal of the U. S. S. *Rapidan*, 1844, bears a notation that an applicant for surgeon's steward was found disqualified for appointment on account of physical disability.

Originally surgeon's stewards were enlisted as landsmen or seamen, and were appointed by the commanding officer on the recommendation of the surgeon of the vessel. They were classed as petty officers and could be disgraced for incompetency or misbehavior.

By general order of the Navy Department, November 11, 1861, their status was changed to "appointed petty officer"; appointments were made for the "duration of the cruise" and they were subject to discharge for misbehavior, "the fact of misbehavior to be established by a summary court."

The title of surgeon's steward was changed to apothecary by circular order of the Navy Department, dated December 8, 1866. This order reads: "The designation of persons serving as surgeon's steward is changed to that of apothecary, and they will be appointed for duty in the Medical Department of the Navy, ashore and afloat, in the same manner as surgeon's stewards have heretofore been appointed. Apothecaries of the first class will rank with boatswains, * * * , Apothecaries of the second class will rank with boatswain's mates in charge, * * * , Apothecaries of the third class will rank with boatswain's mates."

United States Naval Regulations, 1893, article 1683, prescribed that: "Apothecaries for shore stations shall, with the approval of the Secretary of the Navy, be appointed by the Chief of the Bureau of Medicine and Surgery."

United States Naval Regulations, 1896, article 797, prescribed that: "A candidate for examination and first enlistment as apothecary must be a graduate of some recognized college of pharmacy."

The title of "apothecary" was changed to "hospital steward" by act of Congress of June 17, 1898.

The Hospital Corps of the United States Navy came into existence as an organized unit of the Medical Department under the provisions of an act of Congress, approved June 17, 1898.

This act established the grade of pharmacist, and the ratings of hospital steward, hospital apprentice, first class, and hospital apprentice; provided for appointments to the grade of pharmacist, and the enlisted ratings; fixed the pay and allowances; and specified the duties to be performed.

An act of Congress, approved August 22, 1912, provided that pharmacists after six years from date of warrant and after satisfactorily passing the prescribed examination should be commissioned chief pharmacists, and when so commissioned, have the rank, pay, and allowances of a chief boatswain.

The present organization of the Hospital Corps is in accordance with an act of Congress, approved August 29, 1916, and it is considered of sufficient importance, as a matter of general information to all hospital corpsmen, to quote the text of this act relating to the Hospital Corps in full.

"Hereafter the authorized strength of the Hospital Corps of the Navy shall equal three and one-half per centum of the authorized strength of the Navy and Marine Corps, and shall be in addition thereto, and as soon as the

necessary transfers or appointments may be effected the Hospital Corps of the United States Navy shall consist of the following grades and ratings: Chief pharmacists, pharmacists, and enlisted men classified as chief pharmacist's mates; pharmacist's mates, first class; pharmacist's mates, second class; pharmacist's mates, third class; hospital apprentices, first class; and hospital apprentices, second class; such classifications in enlisted ratings to correspond respectively to the enlisted ratings, seaman branch, of chief petty officers; petty officers, first class; petty officers, second class; petty officers, third class; seaman, first class; and seaman, second class; *Provided*, That enlisted men of other ratings in the Navy and in the Marine Corps shall be eligible for transfer to the Hospital Corps, and men of that corps to other ratings in the Navy and the Marine Corps.

"The President may hereafter, from time to time, appoint as many pharmacists as may be deemed necessary, from the rating of chief pharmacist's mate, subject to such moral, physical, and professional examinations and requirements as to length of service as the Secretary of the Navy may prescribe; *Provided*, That the pharmacists now in the Hospital Corps of the United States Navy or hereafter appointed therein in accordance with the provisions of the act shall have the same rank, pay, and allowances as are now or may hereafter be allowed other warrant officers.

"Pharmacists shall, after six years from the date of warrant, be commissioned chief pharmacists after passing satisfactorily such examinations as the Secretary of the Navy may prescribe, and shall, when so commissioned, have the same rank, pay, and allowances as now or may hereafter be allowed other commissioned warrant officers; *Provided*, That the pharmacists at present in the service who have served or may hereafter serve six or more years in that grade shall be eligible for promotion to the grade of chief pharmacist upon satisfactorily passing the examinations provided for in this act.

"The secretary of the Navy is hereby empowered to limit and fix the numbers in the various ratings.

"Section three of an act entitled 'An act to organize a Hospital Corps of the Navy of the United States; to define its duties and regulate its pay,' approved June seventeenth, eighteen hundred and ninety-eight, be, and the same is hereby, repealed, and the pay, allowances, and emoluments of the enlisted men of the Hospital Corps shall be the same as are now, or may hereafter be, allowed for respective corresponding ratings, except the rating of turret captain of the first class in the seaman branch of the Navy; *Provided*, That the pay of the rating of the chief pharmacist's mate shall be the same as that now allowed for the existing rating of hospital steward.

"Hospital and ambulance service with such commands and at such places as may be prescribed by the Secretary of the Navy, shall be performed by members of said corps, and the corps shall be a constituent part of the Medical Department of the Navy; and the enlisted men thereof shall be a part of the enlisted force provided by law for the Navy.

"Officers and enlisted men of the Medical Department of the Navy, serving with a body of marines detached for service with the Army in accordance with the provisions of section sixteen hundred and twenty-one of the Revised Statutes, shall, while so serving, be subject to the rules and articles of war prescribed for the government of the Army in the same manner as the officers and men of the Marine Corps while so serving."

CHAPTER II.

ANATOMY AND PHYSIOLOGY.¹

The human body is composed of a combination of several systems of organs, which fulfill special functions. These systems are further divided into their component tissues, which are collections of the fundamental unit, the cell.

Anatomy is the study of the structure of the body and the relation of the different tissues and organs of the body to one another, in fact, it is a rather comprehensive term which includes several closely related branches of study. The structure of the individual is not the same at all periods of life, differing to a marked degree in the fetus, the new-born child and the adult.

Embryology is a study of the development of the offspring from the beginning of the germ cell, or fertilization, to birth.

Histology, or microscopical anatomy, is a study of the minute structure of the normal tissues of the body.

Comparative anatomy, or morphology, is the study and comparison of the structural aspects of different animals to each other.

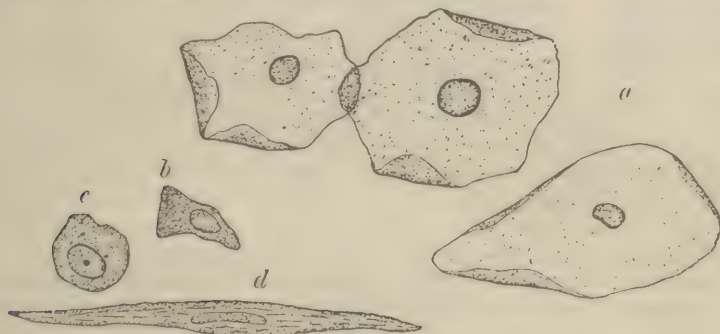


FIG. 1.—Various forms of cells: *a*, Squamous epithelium from the tongue; *b*, columnar cell from the small intestine; *c*, a polyhedral or spheroidal cell from the liver; *d*, a smooth-muscle cell from the muscular coat of the stomach. $\times 550$. (Ferguson.)

Physiology is the science which treats of the function of living bodies, and teaches the use and activity of the various organs in life.

Pathology is the science which treats of the modifications of function and changes in structure of living bodies caused by disease.

The *cell* is the fundamental unit of structure and function of all the tissues of the body. It is made of a mass of *protoplasm*, which is divided into two parts, the cell body, or *cytoplasm*, a granular or gelatinous fluid held in a spongy network and limited in most cases by a cell wall; and an essential organ known as the *nucleus*, which contains granules called *chromatin*. These cells vary in shape, size, structure of protoplasm, and staining qualities, as well as in shape, size, and location of nucleus within the cell. Every cell is formed by the division of a preexisting cell. Every cell has a definite life cycle. It grows, performs its proper function, and ceases to exist, either by dividing into two daughter cells, or by dying and breaking up into fragments. (Fig. 1.)

¹ Prepared by Lieut. W. E. Golden, Medical Corps, United States Navy; reviewed by Lieut. F. C. Hill, Medical Corps, United States Navy.

The tissues are collections of cells of constant structure and function, and although the tissues may be modified by situation, they can always be identified when studied microscopically.

There are five fundamental tissues, *epithelial*, *connective*, *muscular*, *nervous*, and *fluid*, and each of these are characterized by certain peculiarities of structure and function. The epithelial tissues are formed of different types of epithelial cells with a small amount of *intercellular substance*, and make up the covering of mucous membranes, glandular substance, and the free surface of the skin. There are several types of epithelial cells, depending on the function they perform. Perhaps the simplest classification of epithelial cells is with regard to shape. The flat cells of the skin, mouth, and urethra are called *squamous* cells, and the irregularly shaped cells found in glands, the intestines, trachea, and bronchi are called *columnar* cells.

Some of the cells are specialized in order that they can perform certain functions. The columnar cells of the trachea have upon their free margin

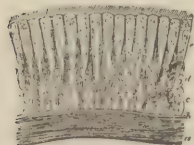


FIG. 2.—Ciliary epithelium. (Kölliher.)

minute hair-like projections called *cilia*, which, by a wavelike motion toward the mouth, aid in discharging secretions from the lungs. (Fig. 2.) Other epithelial cells partake of the nature of nervous tissue and by their specialization enable us to see, hear, taste, and smell, and afford the sense of touch. They are *neuroepithelial* cells.

Connective tissue is the supporting tissue of the body. In this tissue the cells are scanty, and the intercellular substance considerable. A new element is found here, the *connective tissue fiber*. This tissue may be modified by the deposition of mineral salts, fat, gelatin, or elastin. The various forms of connective tissue are *areolar tissue*, a loose network found under the skin and between muscle fibers; dense *fibrous tissue* found in tendons, ligaments, and surrounding various organs; *adipose tissue* or fat; *lymphoid tissue*, as the tonsils, adenoids, and spleen; *cartilaginous*; *osseous tissue* or *bone*; and *dentine*.

THE BONES AND JOINTS.

Osteology is the study of the skeletal system which is composed of the bones and certain cartilaginous and membranous parts associated with them. It includes the study of the structure of individual bones.

Arthrology or *syndesmology* is the study of the joints or articulations, taking into consideration the parts forming the joints, and the mechanism of each joint.

The *skeleton* is the bony framework of the body. Its function is to support the body, preserve shape, protect certain vital organs, and to afford attachments for muscles in order that complicated movements may be effected. (Fig. 3.)

Bone or osseous tissue, may be regarded as white fibrous connective tissue which has undergone calcification by deposition of certain lime salts. These salts increase in quantity as a person ages, making the bones harder but more brittle. The bones are made up of an outer shell of hard compact tissue, and an inner part of spongy or *cancellous* tissue, which is filled with large marrow cavities. (Fig. 4.) The bone *marrow* is of two types, yellow marrow, composed chiefly of fat, found in the medullary cavities of long bones; and red marrow, containing very little fat and abundantly supplied with blood, found chiefly in the spongy tissue. The true *marrow cell*, which resembles in some

respects colorless red blood corpuscles, is found here. In addition to these there are reddish colored nucleated cells, the *erythroblasts*, from which the red blood corpuscles are formed.

The ends and facets of bone are covered by cartilage, which forms the articulating surfaces, and enters into the formation of joints. All those portions of the bone not covered by an articular cartilage are covered by a thin, vascular membrane of fibrous tissue called *periosteum*. This membrane has the power of generating new bone, and serves this purpose in the normal growth of bone and when the original bone has been destroyed.

Bone is nourished from small arteries, one or more for each bone, which enter the bone by small openings called *nutrient canals* or *foramina*. It also receives nourishment from capillaries of the periosteum which dip down into small irregularities or pits in the bone surface.

Bone is developed by the ossification of cartilage or certain membranes. This ossification begins in the embryo and is not completed until adult life. In a long bone, the primary center of ossification is in the shaft and is called the *diaphysis*; at a later stage one or more secondary centers of ossification called *epiphyses* appear in the cartilaginous knobs at the ends of

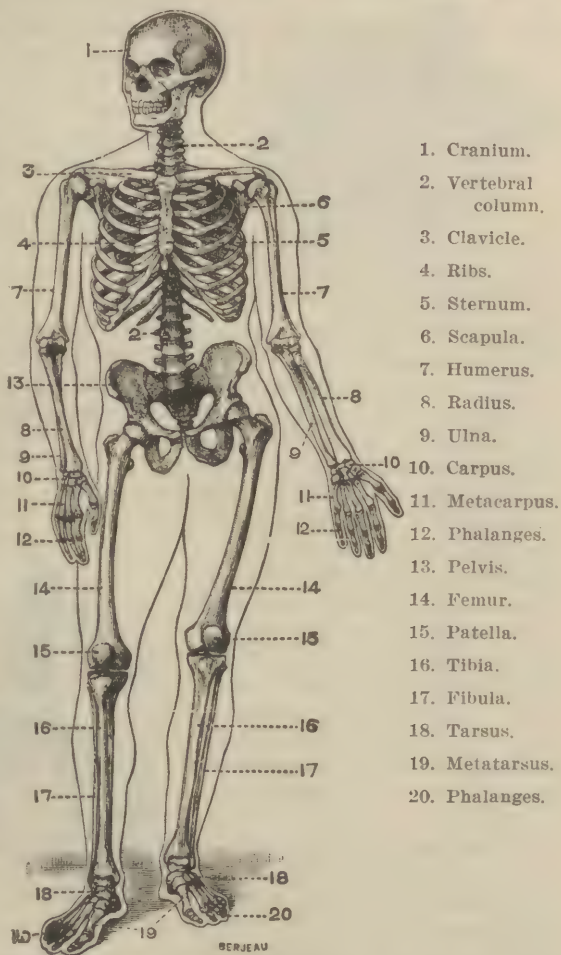


FIG. 3.—The skeleton. (Manual of Instruction, Royal Naval Sick Berth Staff.)

the shaft. Complete fusion by osseous union of epiphysis and diaphysis occurs at variable periods of life and prior to this union the two are bound together by a cartilaginous union called the *epiphyseal line*. Because of this cartilaginous union the extremities in youth are better able to withstand shocks and jars. The periosteum produces growth in the circumference of long bones, but another factor is concerned in an increase in the length of these bones. The two parts of the bone, the diaphysis and epiphysis, are separated by a zone of cartilage which is extremely active in the growth of bone

due to invasion of vessels and cells from the vascular zone which surrounds the epiphysis. This provides for the growth of the shaft toward the epiphysis and the epiphysis toward the shaft, and continues as long as the intervening layer of cartilage persists.

Two hundred and six bones make up the bony framework or skeleton; this includes the bones of the ear, and the patellæ.

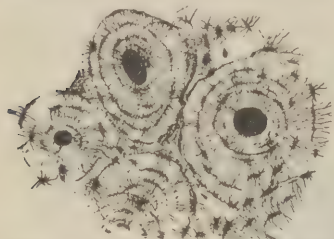


FIG. 4.—Transverse section of compact tissue of bone. Magnified about 150 diameters. (Sharpey.)

Bones are classified as to type as follows: *Long, short, flat, and irregular.* A long bone consists of a *shaft* and two *extremities*. The shaft is formed of compact tissue, which is thickest in the middle, where the bone is most slender and the strain greatest and is hollowed out in the interior to form the *medullary canal*. The extremities are made up of cancellous tissue with a thin coating of compact substance, and are more or less expanded for greater convenience of articulation and to afford a broad surface for muscular attachments, as seen in the femur and the humerus. Short bones are small and irregularly shaped. Their texture is spongy throughout, except for a thin crust of compact tissue covering the surface, as in the bones of the wrists and ankles. Flat bones are found where the principal requirement is either extensive protection or the provision of broad surfaces for muscular attachment. The bony tissue is formed into broad or elongated flat plates which are composed of compact tissue enclosing a variable amount of cancellous tissue, as in the bones of the cranium, the sternum and the hip bones. Irregular bones are those which, on account of their peculiar shape, can not be grouped under any of the preceding heads; for example, the vertebræ, the mandible and the hyoid bones.

In studying the topography or surface markings of bones it is necessary to understand the following terms:

Process—any marked bony prominence; *tuberosity*—a large process; *tubercle*—a small process; *spine*—a sharp, slender process; *condyle*—a rounded knuckle-like process; *crest*—a narrow ridge of bone; *head*—a portion of a bone supported on a constricted part or *neck*.

The divisions of the skeleton are tabulated below:

Head or skull: The bones of the cranium, the face, and the ear ossicles.

Hyoid bone: A U-shaped bone located in the base of the tongue, between the mandible and larynx, connected by ligaments to the styloid processes of the

Bones are classified as to type as follows: *Long, short, flat, and irregular.* A long bone consists of a *shaft* and two *extremities*. The shaft is formed of compact tissue, which is thickest in the middle, where the bone is most slender and the strain greatest and is hollowed out in the interior to form the *medullary canal*. The extremities are made up of cancellous tissue with a thin coating of compact substance, and are more or less expanded for greater convenience of articulation and to afford a broad surface for muscular attachments, as seen in the femur and the humerus. Short bones are small and irregularly shaped. Their texture is spongy throughout, except for a thin crust of compact tissue covering the surface, as in the bones of the wrists and ankles. Flat bones are found where the principal requirement is either extensive protection or the provision of broad surfaces for muscular attachment. The bony tissue is formed into broad or elongated flat plates which are composed of compact tissue enclosing a variable amount of cancellous tissue, as in the bones of the cranium, the sternum and the hip bones. Irregular bones are those which, on account of their peculiar shape, can not be grouped under any of the preceding heads; for example, the vertebræ, the mandible and the hyoid bones.



FIG. 5.—Skull: *a*, Nasal bones; *b*, superior maxilla; *c*, mandible; *d*, occipital bone; *e*, temporal bone; *f*, parietal bone; *g*, frontal bone. (Mason.)

temporal bones, and serving as attachment for some of the muscles of the neck connected with deglutition and respiration.

Trunk: The vertebræ, the sternum, and the ribs.

Upper extremities.

Lower extremities.

The head.

The head or skull is divisible into the cranium or brain case and the anterior region or face. (Fig. 5.)

The *cranium* is elliptical in shape. The bones are united along irregular lines called *sutures*, and form immovable joints. The bones of the upper, or dome-shaped part are very hard and afford protection to the delicate brain tissue contained within the cranial cavity. The bones of the lower part or *base* are somewhat thinner and softer and are pierced by various openings called *foramina*, through which pass nerves and blood vessels. The largest of these openings is the *foramen magnum*, through which pass the spinal cord, its coverings, certain cranial nerves, and the vertebral arteries.

The dome of the cranium is made up of the following bones, the *two parietals*, the *frontal*, the upper part of the *occipital*, and the *two temporals*. The base is made up of the *sphenoid*, the *ethmoid*, the lower part of the *occipital*, and the *two temporals*. In all, eight bones make up the cranium. Some of the bones of the cranium contain small cavities or *sinuses*, which are connected by small openings to either the nasal cavity or the middle ear. The frontal bone has two of these cavities, one over each eye, called the *frontal sinuses*, which connect with the nasal cavity, as also do the cavities found in the ethmoid, the sphenoid, and maxillæ. The temporal bones contain numerous small cavities in a prominence called the *mastoid process*. These cavities open into the middle ear.

Fourteen bones make up the face. There are *two nasals* forming the bridge of the nose, *two maxillaries* forming the upper jaw and part of the frame work of the face; *two lachrymals*, small fragile bones forming part of the inner wall of the orbit; *two turbinate bones*, small protuberances on the outer wall of each nostril; *two palate bones*, forming the back part of the hard palate and part of the floor and outer wall of the nasal fossa; *two malar or zygomatic bones*, the cheek bones; the *vomer* which forms a part of the central septum of the nose; and the *mandible* or lower jaw.

The bones of the face form the oral or mouth cavity, and in conjunction with the cranial bones form the orbital cavities or eye sockets, and the nasal cavities. The external auditory canal, the middle ear, and the internal ear are contained in the temporal bone.

In the middle ear there is a jointed chain of three small movable bones named the *malleus* (*hammer*), the *incus* (*anvil*), and the *stapes* (*stirrup*). These bones communicate the vibrations of the eardrum to the internal ear.

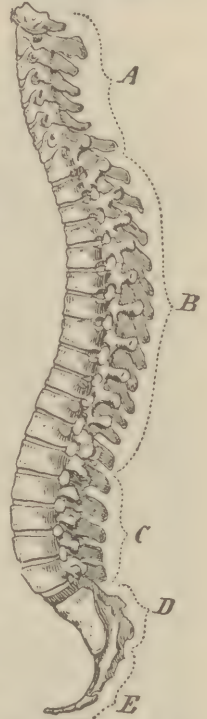


FIG. 6.—Spinal column: A, Cervical; B, dorsal; C, lumbar; D, sacrum; E, coccyx. (Mason.)

The trunk.

The spinal or vertebral column is formed by a series of bones called *vertebrae*, and, in a man of average height, is about 28 inches long. In youth these bones number 33, and according to the positions they occupy are named:

The *cervical* (7), in the neck; the *thoracic* (12), in the thorax; the *lumbar* (5), in the loins; the *sacral* (5), in the pelvis; and the *coccygeal* (4), in the pelvis. The vertebrae of the three upper portions of the spine are separated and movable throughout life and are known as true vertebrae. In the adult those of the lower two portions are firmly united into two bones, five to form the sacrum, and four to form the coccyx and are known as false vertebrae. (Fig. 6.)

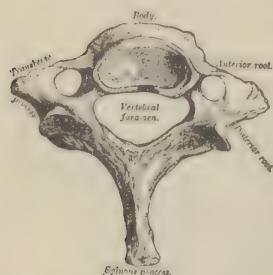


FIG. 7.—Seventh cervical vertebra. (Gray.)

Each vertebra consists of two essential parts, an anterior solid portion or *body*, and a posterior portion or *arch*. Each arch has seven processes, four *articular*, two *lateral*, and one *spinous* which projects backward. The structure of the vertebrae varies somewhat in each region, dependent upon mobility and necessity for strength for support. (Fig. 7.)

Viewed from the side, the spinal column shows three curves, which are alternately convex and concave. The two concave or backward curves, in the thoracic and pelvic or sacral regions, are designed for the accommodation of viscera, and the two convex or forward curves, in the neck and lumbar regions are compensatory curves, the result of an upright position.

The *thorax* is a conical elongated bony cage formed by the sternum and costal cartilages in front, the 12 ribs on each side, and the bodies of the 12 thoracic vertebrae behind. It contains and protects the principal organs of circulation and respiration. (Fig. 8.)

The *sternum* or breast bone is a flat, narrow bone, situated in the median line in front of the chest and consists of three parts. The upper part, called the *manubrium*, is triangular in shape, the apex of the triangle joining the middle part of the sternum, which is called the *gladiolus*. The third part, the *ensiform* or *xiphoid process*, is a small thin piece of bone, cartilaginous in youth, which extends from the lower end of the gladiolus. On either side of the sternum are notches for the attachment of the costal cartilages. At the upper part of the manubrium are notches, one on either side, for attachment of the clavicles.

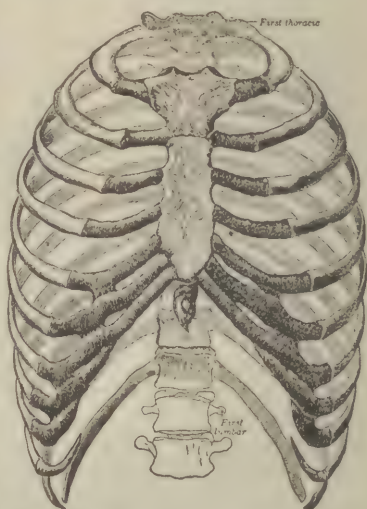


FIG. 8.—The thorax. Ventral view. (Gray.)

The *ribs*, 24 in number, are situated 12 on each side of the thoracic cavity. They all are connected with the thoracic vertebrae at the back. The first seven pairs are connected by costal cartilages with the sternum in front and are called the *true ribs*. The cartilages of the eighth, ninth, and tenth ribs are fused together, and these ribs therefore are called *false ribs*. The eleventh

and twelfth ribs have no cartilages attaching them to the sternum and are called the *floating ribs*.

The upper extremity.

The bones of the upper extremity are: The collar bone or *clavicle*; the shoulder blade or *scapula*; the bone of the arm or the *humerus*; the bones of the forearm or the *radius* and the *ulna*; the 8 bones of the wrist or the *carpal bones*; the 5 bones forming the palm of the hand, or the *metacarpal bones*; and the 14 bones of the fingers or *phalanges*.

The carpal bones consist of the *navicular* (scaphoid); the *os lunatum* (semilunar); the *os triquetrum* (cuneiform); the *os pisiforme* (pisiform); the *greater multangular* (trapezium); the *lesser multangular* (trapezoid); the *os capitatum* (os magnum) and the *os hamatum* (unciform).²

The *clavicle* is a long bone attached at the inner end to the upper border of the sternum. (Fig. 9.) It extends outward, in a horizontal plane, over the first rib, and is attached at its outer end to the acromion process of the scapula. The muscular attachments are some of the auxiliary muscles of respiration, the pectoral n. *sterno-mastoid*, the *sterno-hyoid*, and the shoulder muscles, the *deltoid* and the *trapezius*. The function of the clavicle is to hold the shoulders backward, thus maintaining an erect posture. Fracture of this bone allows the shoulder to move downward, inward, and forward.

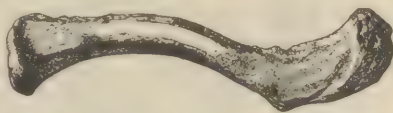


FIG. 9.—The clavicle. (Mason.)



FIG. 10.—Posterior aspect of right scapula. (Potter.)

The *scapula* is a flat, triangular bone, situated in the upper lateral, and posterior aspect of the trunk, from the second to the seventh rib, its posterior border being about 1 inch from the vertebral column. (Fig. 10.) On the posterior surface it has a triangular process called the *spine*, which ends laterally in the *acromion process*, articulating with the clavicle. On the superior margin of the scapula is a hook-like projection called the *coracoid process*. Just inferior to the coracoid and the acromion processes, on the lateral margin is a smooth concave surface, the *glenoid fossa*, for articulation with

the head of the humerus. The anterior surface of the scapula is practically smooth and serves as the attachment for the subscapularis muscle. There are 17 muscles attached to the scapula. These muscles serve as auxiliary muscles of respiration and assist in moving the arm and the head.

The *humerus* is a long bone having a shaft and two extremities and reaches from the shoulder to the elbow. (Fig. 11.) The upper end, or head, is smooth and rounded, and articulates with the scapula forming the shoulder joint. Just below the head the circumference of the shaft is constricted to form

² The Basle anatomical terminology is used throughout this chapter. Readers who are familiar with the old terminology are referred to Cunningham's Text Book of Anatomy, which gives the old term in parenthesis immediately following those of the Basle terminology, as shown in the above paragraph.

the *anatomical neck*. Below the anatomical neck are two knobs known as the *greater* and the *lesser tuberosities*, to which are attached the muscles which hold the bone in place and assist in movements of the shoulder joint. The upper part of the shaft just below the tuberosities is called the *surgical neck* because of the frequency of fracture at this point. The shaft is cylindrical in



FIG. 11.—Humerus.
(Potter.)

shape in its upper half, becomes somewhat flattened in the lower one-third, and terminates in the surface, articulating with the bones of the forearm. On the anterior side of the humerus, just above the articular surface, are two small depressions, the *coronoid fossa*, which receives the coronoid process of the ulna, and the *radial fossa*, which receives the head of the radius when the forearm is flexed. On the posterior part of this same surface is a deep depression, the *olecranon fossa*, which receives the olecranon process of the ulna when the forearm is extended. On either side of these articular surfaces are projections of the bone called the *lateral* and the *medial epicondyles*, which serve as the origin of certain groups of muscles which function in the movements of the forearm.

In the forearm there are two long bones, the radius and the ulna, which extend from elbow to wrist. (Fig. 12.)

The *ulna* is on the little finger side and the *radius* on the thumb side of the forearm. The ulna is largest at the elbow and small at the wrist, while the reverse is true of the radius. On the upper extremity of the ulna there are two prominent eminences, the *olecranon* and *coronoid processes*, and two cavities, the *incisura semilunaris* and *incisura radialis*. The *olecranon process* is situated on the upper and back part and forms the projection commonly called the elbow; the *coronoid* is on the front and upper part. Between these two processes is a semilunar depression called the *incisura semilunaris*, which forms the articular surface of the ulna with the humerus. The *incisura radialis* is a small depression external to the coronoid process and articulates with the radius. Both bones articulate with the humerus to form the elbow joint. On the upper third of both the radius and the ulna are tuberosities for the attachment of muscles.

At the lower end of the ulna, projecting medially, is a process of bone called the *styloid process*. There is a corresponding but larger process on the external surface of the radius, at its lower extremity, likewise called the *styloid process*. The lower extremities of the two bones articulate with each other, but the radius alone enters into the formation of the wrist joint and articulates with the *os navicularis*, and the *os lunatum*.

The *ossa carpi*, or bones of the wrist are arranged in two rows of four each and due to their peculiar shapes and the multiplicity of articulating surfaces are capable of being moved in almost any direction.

The bones of the hand are small long bones called *metacarpals*, five in all. They are numbered in order, the first being that of the thumb and the fifth that of the little finger.

The bones of the fingers are also small long bones, called *phalanges*. There are 14, 3 for each finger and 2 for each thumb. The first or terminal phalanx



FIG. 12.—Radius and ulna.
(Mason.)

of each finger articulates with the corresponding metacarpal bone. The other two phalanges are known, respectively, as the middle and distal phalanges. The bones of the thumbs are called the terminal and the distal phalanges.

The lower extremity.

The bones of the lower extremity are the *os coxæ* (os innominatum or hip bone); the *femur* (or thigh bone); the *patella* (or knee cap); the *tibia* (or shin bone); the *fibula* (or calf bone); seven *tarsal bones*, the *talus* (astragalus), *calcaneus*, *navicular*, first, second and third *cuneiform* and the *cuboid*; five *metatarsal bones*; and fourteen *phalanges*.

The *pelvis* is made up of the hip bones articulating with the sacrum dorsally and with each other ventrally at the joint called the *symphysis pubis*. (Fig. 13.)

The *hip bone* (*os coxæ*) is a large irregular bone, composed of three segments called the *ilium*, the *pubis*, and the *ischium*. The former is the large flat part of the bone, the crest of which forms the hip. It articulates posteriorly with the sacrum, and anteriorly is contiguous with the pubic bone. The angular portion of this bone, the *pubis*, articulates with its fellow on the opposite side at the *symphysis pubis* and forms the *pubic arch*. The third portion, the *ischium*, is also angular and forms the lower part of the *os coxæ*. The three portions unite and form, on the external aspect, a smooth hollow cavity called the *acetabulum* which receives the head of the *femur* and forms the articulation of that bone with the *os coxæ*. An opening, the *obturator foramen*, situated between the three portions of the *os coxæ* in front of, below, and medial to the *acetabulum* affords passage for muscles, nerves, and blood vessels. There are several important bony landmarks on the *os coxæ*; the *crest of the ilium* which terminates anteriorly in a bony process called the *anterior superior iliac spine*; the *pubic spine* on the upper surface of the pubic bone near the *symphysis*; the *greater sciatic notch* which is just above the *acetabulum*; and the *lesser sciatic notch* which is just below the greater sciatic notch and separated from it by the *ischial spine*.



FIG. 13.—Pelvis (adult). (Gray.)



FIG. 14.—Femur.
(Mason.)

The muscles attached to the hip bones are those of the abdomen and back and those utilized in moving the legs.

The *femur* is the longest and the strongest bone in the body. It extends from the hip to the knee of each lower extremity. (Fig. 14.) The upper portion of the femur consists of a rounded head, which is joined to the shaft by a constricted neck. Two eminences are found on the upper part of the shaft of the femur—the *greater trochanter*, which caps the upper and lateral part of the shaft and overhangs the neck of the femur from above and behind; and the *lesser trochanter*, which is situated on the upper dorsal aspect of the shaft where the latter becomes continuous with the neck of the femur. The head articulates with the *acetabular cavity* in the hip bone. The lower portion of the femur is larger than the upper, and is flattened on its posterior and an-

terior surfaces to form two large bony eminences, one on each side, called the *lateral (outer)* and *medial (inner) condyles*. These condyles are separated in front by a smooth depression which articulates with the patella. On the upper part of the medial condyle is a bony process, the *adductor tubercle*, to which are attached the adductor muscles of the thigh. The anterior and inferior surfaces of the condyles articulate with the patella and tibia. On the outer surface of the lateral condyle and the inner surface of the medial condyle are projections of bone, called the *lateral* and the *medial epicondyles*, to which are attached some of the ligaments of the knee.

The *patella*, or knee cap, is a sesamoid bone, somewhat triangular in shape, situated in the tendon of the quadriceps muscle. It forms part of the knee joint.

The two bones of the leg, the tibia and the fibula, are long bones. (Fig. 15.) The *tibia* extends from the knee joint to the ankle joint. Its upper surface is large and expanded into two lateral eminences with concave surfaces which receive the condyles of the femur. The lower extremity of the tibia is smaller than the upper portion and extends downward on the inner side to form the *medial malleolus*. The lower end of the tibia articulates with the fibula and the talus (astragalus) to form the ankle joint.



FIG. 15. Tibia and fibula. (Mason.)

The *fibula* is external to and articulates with the tibia just below its lateral condyle. At its lower end the fibula articulates with the talus and the tibia, and the outer side is prolonged to form the *lateral malleolus* at the lower external portion.

The seven *tarsals* or ankle bones are of irregular form and vary in size. The *talus* articulates with the tibia and the fibula above and the calcaneus and the navicular bones below. The *calcaneus* or heel bone is the largest tarsal bone. It forms the heel and articulates with the talus and the cuboid which in turn articulates with the fourth and fifth metatarsals. The *navicular* bone, placed between the talus and the first, second, and third cuneiform bones, is the key stone of

the *pedal arch* and any luxation on its part tends to produce flat feet. The three *cuneiform* bones articulate respectively with the first, second, and third metatarsal bones.

The remaining bones of the foot correspond to those of the hand except that the bones which correspond to the metacarpals are termed the metatarsal bones.

Joints.

The various bones composing the skeleton are connected to one another at different parts of their surfaces. These unions are called joints.

The three types of joints are the *immovable joints*, such as those of the cranium and the face (excepting the lower jaw); the *partly movable joints*, such as the symphysis pubis and the lower tibio-fibular articulation; and the *true or freely movable joints*, such as the hip and the shoulder joints.

The movable joints may be divided into *gliding joints*, such as those between the articular processes of the vertebrae, the *hinge joints*, with movements to and fro in one plane, as the elbow (fig. 16), the knee, the finger and the toe joints; the *ball and socket joints*, consisting of a rounded head of one bone which is received into a cup-like cavity of another, as the hip and shoulder joints; the *rotary joint* in which one bone rotates on another which is station-

ary, as the first and second vertebrae; the *condyloid joints* in which an oval head is received into an elliptical cavity, as the metacarpo-phalangeal joints; and the *saddle joints* in which each articulating surface is concave in one direction and convex in another, the bones fitting together in the manner of a man in a saddle, as the joint formed by the greater multangular and first metacarpal bones.

The structures which enter into the formation of joints vary with the type of articulation. In every instance there are two or more skeletal elements (bone or cartilage) and in addition a uniting medium, the amount and type of which depends on the type of the joint. In immovable joints this medium consists of a very thin layer of the common matrix, either fibrous membrane or cartilage. In slightly movable joints this connecting membrane or cartilage may be more fully developed. In the freely movable joints there is a joint cavity which is surrounded by an articular capsule of fibrous tissue. The capsule and intra-articular surfaces of the bones are lined with a synovial membrane which secretes synovial or joint fluid into the cavity. Each articular surface of bone is covered with a layer of cartilage, and in some joints there are discs of cartilage called *intraarticular discs* which are inserted into the joint cavities. In many joints where extra strength is needed accessory joint ligaments are present as in the case of the knee and the elbow joints.

Joints permit movements of the skeletal parts with each other. The kinds of movements are as follows:

Flexion—bending, as in raising the forearm on the arm; *extension*—straightening of a limb or part; *abduction*—drawing a member away from the medial line of the body; *adduction*—bringing a member toward the medial line of the body; *rotation*—turning on its own axis; *circumduction*—a combination of flexion, extension, adduction, and abduction in such a manner that the joint forms the apex of a cone and the free end of the part travels through a circle which forms the base of the cone.

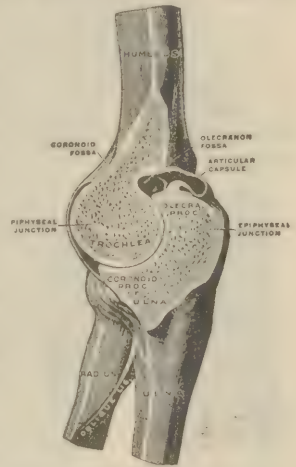


FIG. 16.—Right elbow-joint cut through at right angles to the axis of the trochlea humeri, from the ulnar side. (Spalteholz.)

MYOLOGY OR THE MUSCULAR SYSTEM.

The muscular tissue constitutes a large part of the fleshy portions of the body, enters into the structure of many of the internal organs and forms from forty to fifty per cent of the body weight. It is by the action of this tissue that movements of the body are produced.

Muscle tissue is composed of a number of muscle cells which are held together by delicate connective tissue. The muscle tissue is held together in bundles by a reticular tissue, and forms the various muscles. There are three distinct types of muscle tissue:

The *striated* or voluntary muscle which makes up the skeletal muscles, is subject to voluntary nerve control. (Fig. 17.) The individual muscle cell is elongated, multinuclear and contains striations peculiar to it.

The *nonstriated* or involuntary muscle which makes up most of the muscles of the viscera, except the heart, and which is under the control of the sympathetic nervous system is not subject to stimulation at the volition of the individual. The individual cell of this variety of muscle is plain and without striations.

Cardiac muscle which is involuntary is found only in the heart substance. The muscle cell is made up of short mononucleated cells with striations.

Muscle tissue is a highly specialized tissue and exhibits the following properties:

Irritability—response to stimuli, usually received from nerves; *contractility*—the power which enables muscles to become shorter and thicker on receiving the proper stimuli; *tonicity*—a mild, sustained contraction giving the skeletal muscles firmness and maintaining a slight steady pull on their attachments; *extensibility*—the power of muscles to be stretched.

When a muscle contracts it uses a certain amount of energy to do a certain amount of work. To supply this energy carbohydrates are taken from the blood stream and oxidized to form carbon dioxide and water. There is also some loss on the protein constituent of muscles at each contraction. However, in ordinary activities the blood supply to muscles is increased,

thereby bringing an increase of food materials, carrying away the waste products of metabolism, and thus enabling the muscle to build up and increase its efficiency. In cases of overexertion the toxic products of metabolism will accumulate to such an extent that the phenomena of fatigue is produced and in some cases results in contracture or muscular cramp.

When the muscle substance dies it passes from a viscous to a solid state, becomes rigid and loses its power to react to stimuli. The stiffening and hardening of the muscles after death is due to this phenomena, which is called *rigor mortis*.

The muscles of the body are divided into the following groups: those of the head and face; of the neck; of the trunk, which is subdivided into those of chest, thorax, abdomen, back and perineum; those of the upper extremity; and those of the lower extremity. (Fig. 18.)

The *muscles of the head and face* consist of numerous groups of small muscles which act in the movements of the eyes, the face, the scalp and assist in mastication, deglutition, talking and expression.

The *muscles of the neck* move the head from side to side, backward and forward, and rotate it. Some of these muscles act as auxiliary muscles of respiration, assist in deglutition, in speaking, and in other complicated movements of the head and neck.

The *muscles of the back* are divided into five layers, the superficial layer and four deep layers. They act on the spinal column to keep the trunk in an erect posture, and permit movements from side to side, forward and backward, and a moderate amount of circumduction. Those of the *chest and thorax*, including the *diaphragm*, the great muscle which separates the thoracic from the abdominal cavities, are chiefly respiratory muscles. These muscles, with the exception of the diaphragm, assist in movements of the trunk, the neck and the upper extremities. The *muscles of the abdomen* are the *external oblique*, the *internal oblique*, the *rectus abdominis*, and the *transversus abdominis*. The *rectus* muscle is a paired muscle situated on each side of the

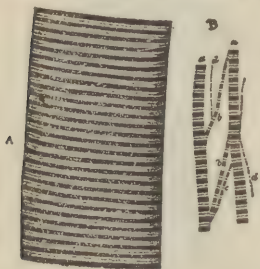


FIG. 17.—Striped muscle fiber. (Sharpey.)

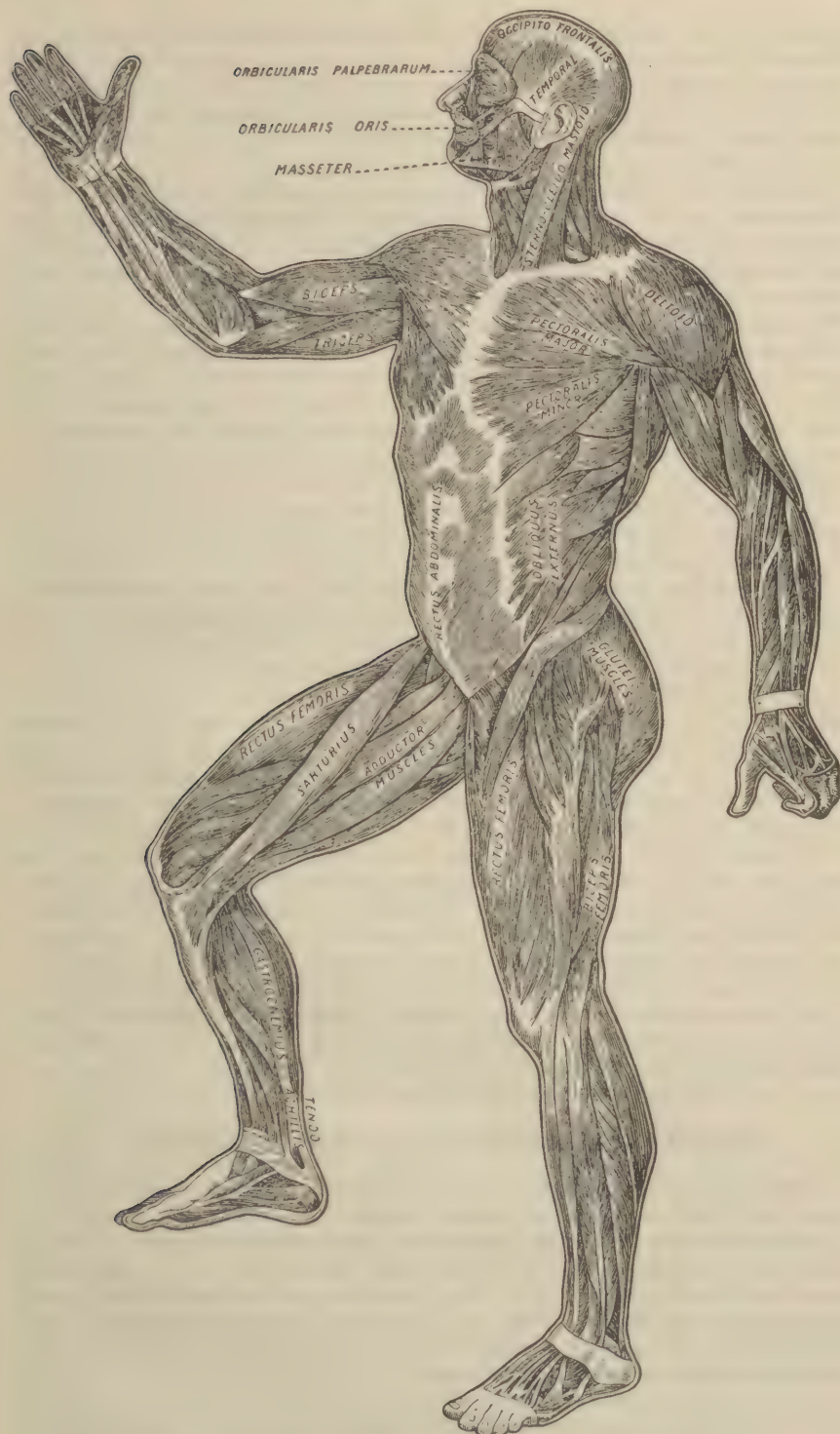


FIG. 18.—Superficial muscles of the body. (After Brubaker.)

median line of the abdomen within the fibrous aponeurosis of the oblique muscles. It extends from the symphysis pubis to the thoracic wall. These muscles form the sides and front of the abdominal wall. They assist in micturition and defæcation by compressing the abdominal viscera. They also assist in respiration and emesis, flex the thorax on the pelvis and aid in lateral flexion and rotation of the spine.

The *inguinal ligament* (Poupart's) is a thickened band of fibers of the aponeurosis of the external oblique muscle, extending from the anterior superior spine of the ilium to the spine of the pubis. Just above this ligament and parallel to it is the inguinal canal through which pass the spermatic cord in the male, and the round ligament of the uterus in the female. The inner opening in the transversalis muscle is called the *internal inguinal ring*; the outer opening in the tendon of the external oblique muscle is called the *external inguinal ring*. These openings form weak places in the abdominal wall, and are the frequent sites of a protrusion of parts of the viscera. Such protrusion is called a *hernia* or rupture. Other weak places are the *umbilicus*, and the *femoral ring* which serves as a passage for the vessels to the lower extremity.

The *muscles of the perineum* are those surrounding the base of the reproductive organs and the rectum and form the floor of the pelvis. Their action is to assist in micturition and defæcation.

The *muscles of the upper extremity* are divided into those of the shoulder, which act to move that joint; those of the arm; those of the forearm; and those of the hand.

The muscles on the front of the arm flex the forearm; those on the back extend it. The same principle applies generally to the muscles which arise from the bones of the forearm and are attached to the bones of the hand or fingers. Some of these muscles however act to *pronate* the hand (turn palmar surface down) and others to *supinate* the hand (turn the palmar surface up). The muscles of the palm and the back of the hand, flex, extend, adduct, abduct and circumduct the fingers and the thumbs.

The *muscles of the lower extremity* are divided into those of the hip; the thigh, the leg and the foot. The muscles on the anterior side of the hip flex the thigh on the abdomen, those on the posterior extend, those on the medial side adduct and those on the lateral side abduct. Combinations of these actions produce circumduction of the lower extremity.

The muscles of the posterior portion of the thigh flex the leg on the thigh. Those of the anterior portion extend the leg. The muscles having origin on the anterior surface and on the posterior surface of the bones of the leg, flex, extend, and circumduct the foot. The muscles of the dorsal and the ventral surfaces of the foot extend and flex the toes respectively.

SPECIAL MEMBRANES AND GLANDS IN GENERAL.

A *membrane* is an enveloping or lining tissue of the body. The chief membranes are classified as: *Serous, synovial, mucous* and *cutaneous*.

Serous membranes are thin, transparent, fairly strong and elastic. Their surfaces are moistened by a fluid resembling serum. They are found lining closed cavities and passages which do not communicate with the exterior. These membranes consist of two layers; the *endothelium*, a modified epithelium, and the *corium*, a thin layer of fibrous tissue and blood and lymph vessels. They are divided into the following three classes:

Serous membranes proper, which consist of a closed sac, one part of which is attached to the walls of the cavity which it lines, and the other reflected over

the surface of the organs contained in that cavity. This class includes the *pleura*, which cover the lungs and line the thoracic cavity; the *pericardium* which covers the heart; the *peritoneum* which lines the abdominal wall, and clothes its contained viscera; the *lining membrane of the vascular system*; the *internal coat of the heart, blood vessels and lymphatics*; the *capsule of Tenon*, back of the eyeball; and the *arachnoid coat of the meninges*. The serous membranes serve as a protective covering by forming a smooth slippery lining and secreting a serum which acts as a lubricating fluid.

Synovial membranes are associated with joints and muscles and secrete a viscid glairy fluid called *synovial* or *joint fluid*. These membranes are *articular*, which surround and lubricate the joints; *vaginal*, which forms the sheaths of tendons about some joints; and *bursal*, which form simple sacs interposed between soft tissue and bone. The latter may be deep seated between muscle or tendon and bone, or superficial between skin and bone, for example, the *patellar bursæ*.

The *mucous membranes* line the cavities which communicate with the exterior. Their surfaces are coated over and protected by mucus. The mucous membranes of the body may be divided into the gastro-pulmonary, and the genito-urinary.

The *gastro-pulmonary mucous membrane* covers the inside of the alimentary tract and the air passages and all cavities communicating with them. This includes the accessory sinuses of the nose; the lachrymal ducts; the conjunctiva; the auditory canals, including the middle ear and the mastoid cells; the common bile duct; the gall bladder; the biliary ducts; the pancreatic duct; and the salivary ducts. The *genito-urinary mucous membrane* furnishes the inside lining of the urethra; the bladder; the ureters; the pelvis and tubules of the kidney; and all of the genital ducts including the prostatic, the seminal and the vas deferens.

The *cutaneous membrane* is the external covering of the body, or skin. Its structure and functions will be discussed later.

A *gland* is an organ which secretes something essential to the system or excretes waste materials, the retention of which would be deleterious to the body.

Glands are of three types; simple, compound, and ductless.

Simple glands are generally tubular or sacular in structure and open to the surface by a single duct.

Compound glands are glands the structure of which is subdivided into smaller tubular or sacular structures which open by smaller ducts into a main duct.

Ductless glands are glandular structures which have no ducts. They discharge their secretion directly into the blood or lymph streams.

THE VASCULAR SYSTEM AND CIRCULATING FLUIDS.

The *blood* is the fluid which circulates through the heart, arteries, veins and capillaries and supplies nutritive material to all parts of the body. Blood is slightly heavier than water (specific gravity of 1.055) and is composed of plasma and corpuscular elements.

The quantity of blood in the adult is estimated at about one twentieth of the body weight, which is about four quarts in an average man weighing one hundred and sixty pounds.

The functions of the blood are as follows: (1) It serves as a medium for the interchange of gases, that is, it carries oxygen to the cells and removes carbon dioxide from the cells. (2) It serves as a medium for the interchange of nutritive and waste materials, that is, it carries nutrient materials to the cells and waste material from them. (3) A medium for the transmission of

internal secretions. (4) It aids in equalizing and maintaining body temperature. (5) It aids in protecting the body from toxic substances, that is, assists in maintaining body resistance.

The cellular contents or elements of the blood are the *red cells*, the *white cells*, and the *blood platelets*.

The *red blood cells* are circular, biconcave discs about $\frac{1}{3200}$ of an inch in diameter. (Fig. 19.) They have no nucleus. Their number, which varies greatly under different conditions of health, is, in the adult male, about five million to five and one half millions per cubic millimeter. Their red color is due to the presence of *hemoglobin*, a substance composed of iron salt and a protein, which has the power of combining easily with oxygen to form oxy-hemoglobin, which is a loose chemical combination in which oxygen is carried from the lungs to the tissues. Hemoglobin also possesses the power of removing carbon dioxide from the tissues in the same manner. The affinity of oxygen and carbon dioxide for hemoglobin depends upon the concentration of these gases at the point of exchange. The oxygen being at a greater concentration in the lungs is combined with the hemoglobin of the blood and forms oxy-hemoglobin, the carbon dioxide being given off. The carbon dioxide being at a greater concentration in the tissues is combined with the hemoglobin and

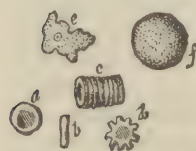


FIG. 19.—*a, b, c, d,* Red cells, side, edge, in rouleaux, crenated; *e, f,* white cells. (Mason.)

forms carbon-dioxide-hemoglobin, the oxygen being given off. In the adult the organ for the reproduction of the red cells is the red marrow of bone. The cells thus produced are nucleated, but lose their nuclei before entering the blood stream. A large number of red corpuscles are destroyed daily, in what manner it is not definitely known. This destruction may take place in the liver, the spleen, or in the lymph nodes. It is known, however, that a certain amount of hematin is excreted daily in the bile, a fact which substantiates the destruction of red blood cells in the liver.

The *white blood corpuscles* are nucleated blood cells which vary in size and shape. They are somewhat larger

than red cells. The average number of white blood cells in a cubic millimeter of blood is from six to eight thousand under normal conditions. An increase in white cells, called *leucocytosis* may occur under varying conditions. The most marked increases of white blood cells occur in certain pathological conditions and infections, and a knowledge of the variations under these conditions is an important aid to diagnosis. *Leucopenia* is a condition in which the white blood cells in the blood are below the normal standard in number. The white blood cells may be divided into two main groups, *leucocytes* and *lymphocytes*.

Leucocytes have the striking property of amœboid movement. They may pass through the walls of the blood vessels into the surrounding tissue. This process is known as migration. The function of the leucocytes is to serve as protective agents to the body. They do this by contributing to the formation of certain antibodies, also by the ingestion and destruction of bacteria, a process called *phagocytosis*. They also aid in the absorption of digested fat and proteins and in the clotting of blood.

The *lymphocytes* may be divided into large and small lymphocytes. The *small lymphocytes* are about the size of the red blood corpuscles. They contain a large round nucleus centrally placed, which stains deeply, and is surrounded by a narrow zone of cytoplasm, which takes a stain less deeply. These cells compose about 20 to 25 per cent of the white blood corpuscles. The *large lymphocytes* have similar staining qualities, but are much larger and contain

more cytoplasm than the small lymphocytes. This large type constitutes 5 to 10 per cent of the white blood corpuscles. The lymphocytes have their origin in the lymph glands, the spleen, and the bone marrow.

Leucocytes may be granular or nongranular. The *nongranular leucocytes* are the large mononuclear cells and the transitional cells. The *large mononuclear* cells have the same general shape as the large lymphocytes, but the nucleus and the cytoplasm stain less deeply. Normally these cells form from 1 to 2 per cent of the total leucocytes. The *transitional cells* are of the general shape and appearance of the preceding, except that the nuclei are characteristically indented on one side and when stained present a more washed-out appearance. These cells constitute about 2 to 4 per cent of white blood cells in normal blood.

The *granular leucocytes* are distinguished on the basis of granules in their cytoplasm. The nuclei of these cells may be of many shapes, and are called *polymorphonuclear leucocytes*. There are three varieties of these cells:

1. *Neutrophiles*, in which the granules take a light lilac stain when stained by one of the Romanowsky methods. These cells make up about two-thirds of the white blood cells.

2. *Eosinophiles*, the granules of which when stained with the above stain take a pink or red tint due to their affinity for the acid element of the stain. These cells compose from 1 to 2 per cent of white blood cells.

3. *Basophiles*, the granules of which take on a violet color, due to affinity for the element of the basic stain. In normal blood they usually amount to less than 1 per cent of the white cells.

The *blood platelets* are small disk-shaped bodies found in the blood. They are smaller than the red blood corpuscles, vary in shape, and are normally present in the blood in the number of about 300,000 per cubic millimeter. They consist only of protoplasm and contain nuclear material. Knowledge of the origin of these platelets is uncertain but it is believed that they are fragments of the blood cells. Their important function is to aid in the clotting of the blood.

The *blood plasma* is a clear, slightly yellowish fluid, containing a variety of substances, and serving as a source of nutrition. It is a means of removing the waste products resulting from the functional activity of the body cells, and also serves as a means of transportation for the blood corpuscles. Plasma consists of water, in which these substances are held in solution or in suspension.

Three proteins are present in the blood plasma—*sero-albumin*, *paraglobulin*, and *fibrinogen*. The significance of the two former proteins is obscure, but the latter, fibrinogen, is essential in forming the insoluble *fibrin* necessary in the process of clotting the blood. Fibrinogen is considered to be produced in the liver. A class of substances known as *extractives*, consisting of food products and waste products as urea, and uric acid, are also present in the blood plasma. Mineral salts, such as the chlorides, sulphates, carbonates, and phosphates of sodium, calcium, and magnesium are very important constituents in the blood plasma and are concerned in the nourishment and the building up of the tissues. The integrity of the red blood corpuscles depends upon the percentage of salt present. The amount of mineral salt is normally equivalent to about nine-tenths of 1 per cent of sodium chloride solution which fluid is isotonic with the tissue fluids. A solution containing less mineral salt, hypotonic, will cause the red blood corpuscles to absorb water. This condition results in the red blood corpuscles swelling and bursting, thus discharging their h  moglobin.

This process is called *hemolysis*, and may be caused by certain bacterial products called *hemolysin*. In case of a solution containing more than the above percentage of salt, water is extracted from the corpuscles and they shrivel or become *crenated*. The above facts must be remembered in intravenous medication.

Other substances found in plasma consist of certain gases, oxygen, nitrogen, and carbon dioxide; internal secretions of glands; certain enzymes; and special substances such as antigens and antibodies.

The most important change effected during coagulation of the blood is the formation of *fibrin*, which results from several preliminary reactions. *Fibrinogen*, the substance from which fibrin arises, is contained in the plasma of the normal blood. It is, however, an inert body and must be activated by a ferment called *thrombin*, in order that fibrin may be produced. Thrombin is not present in normal blood but is formed from the *thrombogen* or *prothrombin* which is contained in the blood. The presence of some form of soluble calcium salts together with an organic thromboplastic agent (*thrombokinase*) is essential in order that the thrombogen may act. When blood is brought into contact with a foreign substance, as air, destruction of *thrombocytes* results. *Thrombokinase* is liberated and acts with the soluble calcium salts in the blood to change the thrombogen into thrombin. The thrombin then acts upon the fibrinogen to form fibrin. Coagulation or clotting is accomplished by these delicate shreds of fibrin which traverse the blood in various directions and encircle large colonies of corpuscles. The meshes of this fibrin network gradually are drawn closer together and the corpuscular elements become more tightly packed together.

This process is expressed diagrammatically as follows:

Cellular elements=thromboplastic substance.

Thromboplastic substance+soluble calcium salts+thrombogen=thrombin.

Thrombin+fibrinogen=fibrin.

The formation of a clot closes the opening of wounded vessels and prevents complete exsanguination. This clotting power differs in different individuals. Normally three to five minutes is a sufficient time for a clot to form but in rare cases even trivial wounds may cause severe and dangerous hemorrhages. This condition in which clotting of the blood is delayed is known as *hemophilia*, and a person having this condition is called a *hemophilic*.

Clotting of the blood may be hastened by the application of heat, as hot towels (wet or dry) or hot douches; by contact of the bleeding surface with foreign substances, as gauze, cotton, etc.; by pressure over the bleeding area, and sometimes by rubbing the part involved to produce an extraction of the cellular elements from the tissues.

A large portion of the entire quantity of the blood may be lost without fatal result to the individual. The plasma of the blood is quickly regenerated by extraction of fluid from the tissues. This process may be artificially performed by the intravenous injection of an isotonic saline solution. A longer time is required to regenerate the cellular contents of the blood, days or weeks being necessary at times.

The *lymph* is a colorless fluid found in the lymph vessels and in all of the tissue or intercellular spaces of the body. It consists of blood plasma and leucocytes and serves as a medium of interchange between the blood and the tissues. It carries nourishment to the tissues and waste materials from them to the blood. This action is carried on by *osmosis* or *dialysis*.

The vascular system.

The organs of the *blood vascular system* are the *heart*, the *arteries*, the *capillaries*, and the *veins*.

The *heart* is a hollow, muscular organ, about the size of a closed fist and is pyramidal in shape. (Fig. 20.) It is located between the lungs in the front and center of the thoracic cavity, and extends from the second costal cartilage above to the interval between the fifth and sixth ribs on the left side, and from about one half inch to the right of the right side of the sternum to about $2\frac{1}{2}$ inches to the left of the left border of the sternum. Its base is held suspended by the *great vessels* and is directed upward, backward, and to the right. The pointed end or the apex points downward, forward, and to the left.

The heart is enclosed in an inverted sac of serous membrane called the *pericardium*. The inner layer of the pericardium is closely adherent to the musculature of the heart; its outer surface is reflected over the inner layer forming a potential cavity which contains a small quantity of fluid, the *pericardial fluid*. This fluid lubricates the surfaces of the pericardium and prevents friction during the movements of the heart. The inside of the heart is lined with a delicate serous membrane called the *endocardium*.

The main portion of the heart is composed of muscular tissue, called the *myocardium*. This muscular tissue is of a special type found only in the heart and is involuntary. The fibers of this tissue are striated and the cells have but one nucleus. (See muscle tissue above.) The arrangement of the muscles of the heart is very intricate. Some muscles run transversely, others longitudinally, others obliquely, and the muscles in the apex make a spiral turn or twist, thus enabling an even obliteration of the cavity of the heart during contraction. A certain amount of reticular tissue, vessels, nerves, and some ganglia are situated between the heart muscles.

The heart cavity is divided by a longitudinal muscular septum into the right and left halves; the right half transmitting venous, and the left half arterial blood. Each half of the heart is divided into two cavities, the upper ones called the *atria* or the *auricles*, and the lower ones called *ventriculi*, or the *ventricles*. (Fig. 21.) During foetal life a communication, the *foramen ovale*, exists between the auricles of the heart. This, however, closes immediately after birth. Each atrium or auricle communicates with its corresponding ventriculum or ventricle by means of an oval aperture, called the *atrio-ventricular* or the *auriculo-ventricular* openings—right and left. The muscular walls of the auricles are much thinner than those of the ventricles and the wall of the left ventricle is much thicker than that of the right ventricle. This difference in development is accounted for by the greater amount of work performed by the ventricles than by

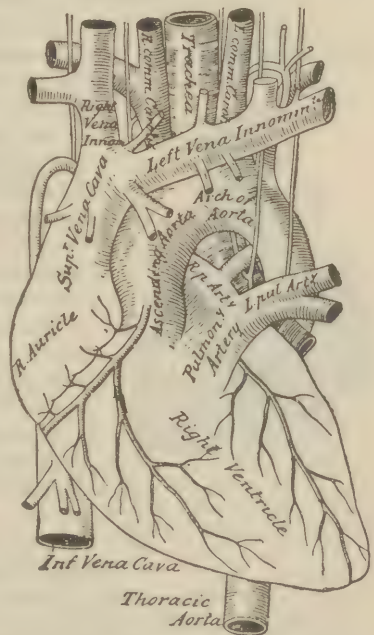


FIG. 20.—The heart. (Mason.)

the auricles, and the corresponding greater amount of work performed by the left ventricle than by the right ventricle.

Each of the cavities of the heart is lined with the *endocardium*, which by folding upon itself forms the *valves* of the heart. These valves guard the various cardiac orifices. The number and shape of the *cusps* or *segments* which make up these valves vary depending upon the location of the valves. At the right auriculo-ventricular orifice the valve known as the *tricuspid valve* consists of three cusps which are triangular in shape. The left auriculo-ventricular valve called the *bicuspid* or *mitral* valve consists of two cusps. At the orifices of the pulmonary artery in the right ventricle and the aorta in the left ventricle are three half-moon-shaped valves called the *semilunar valves*.

The right and left coronary arteries furnish the blood supply to the heart itself. The nerve supply is from the pneumogastric, stimulation of which tends to slow the heart beat, and from the sympathetic nervous system, stimulation of which tends to accelerate the heart beat.

The heart is an automatic organ which during life undergoes rhythmical contraction continuously. The central nervous system may regulate and control these contractions, but it has nothing to do with the cause of these rhythmical contractions, the origin of which is not definitely known. (See references at end of chapter.)

The heart beat consists of an active phase or period of *contraction* called the *systole*, and a period of *dilation* and *rest* called the *diastole*. Normally the heart rate at rest is about 72 beats per minute, but this varies according to age, sex, exercise, temperature, and in certain pathological conditions.

If the ear is applied to the chest, over the area of the heart, certain sounds which recur more or less regularly may be heard. The first sound, a long booming one, is caused by the closure of the auriculo-ventricular valves and by the contraction of the ventricles; the second, a short, sharp sound, is attributed to the closure of the semilunar valves. In certain diseases of the heart these sounds may become altered or obscure and conditions called *murmurs* are frequently produced. These murmurs may be caused by the failure of the valves to close

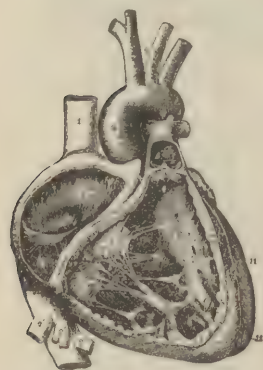


FIG. 21.—Heart, with right auricle and ventricle opened. (Allen Thomson.)

properly, permitting a regurgitation of blood into the cavity from which it is being forced, or by the failure of the valves to open properly, thus partially occluding the passage of blood. This condition is called *stenosis* of the particular valves involved.

The arteries are hollow, elastic tubes possessing a certain amount of rigidity. They carry blood away from the heart. These vessels are composed of three coats, an inner *endothelial lining*, a middle *muscular coat* composed of involuntary muscle tissue and elastic fibrous tissue, and an outer *fibrous coat*. The *muscular tissue* of the arteries is supplied with nerves from the sympathetic system called vasomotor nerves. These serve to cause dilation or constriction of the lumen. The smaller divisions of the arteries are called the *arterioles*.

The *capillaries* are exceedingly minute vessels which are composed of simple endothelial lining only. These vessels communicate with each other and form an interlacing network throughout the body. It is in the capillaries that the chief work of the blood is performed. Here the exchange of food and

waste materials between the blood and the body tissues take place. From the capillaries the blood is collected into the veins.

The *veins* are collapsible vessels which carry blood to the heart. They are similar in structure to the arteries, except that the walls of the veins are thinner; the middle coat contains less muscle tissue and elastic fibers, and in many of the veins are *paired semilunar valves* which act to prevent the backward flow of blood in the veins. (Fig. 22.)

The *general circulatory system* is divided into the *pulmonary circulation* which embraces that extending from the right ventricle to the lungs, at which place the blood is aerated, and its return to the left auricle; and the *systemic circulation* which embraces that extending from the left ventricle through all parts of the body and its return to the right auricle.

To trace the circulation we will begin with the venous blood entering the right auricle by the *inferior* and the *superior vena cava*. This venous blood passes from the right auricle, through the right auriculo-ventricular opening past the tricuspid valves, into the right ventricle. When the right ventricle contracts the tricuspid valve closes and the blood is forced past the pulmonary semilunar valves into the *pulmonary artery*. This artery bifurcates or divides into two branches, one branch going to each lung where it is subdivided into smaller arteries, arterioles, and capillaries which surround the *alveoli* or air sacs, of the lungs. During its circulation in the lungs the blood becomes aerated and is returned via the smaller vessels to the four pulmonary veins, two from each lung, which empty into the left auricle. From the left auricle the blood passes through the left auriculo-ventricular opening past the bicuspid or mitral valve into the left ventricle, where, upon contraction of this part, it is discharged past the aortic semilunar valves into the aorta. From the aorta the blood flows through its branches, the arteries, and the arterioles, to the capillaries in every part of the body. The blood is returned by the capillaries to the veins, and finally reaches the right auricle through the *venæ cavæ*.

The contraction of the left ventricle forcing the blood into the arteries, causes a wavelike expansion of the arteries which is synchronous with a heart beat. This is called the *pulse*, and may be felt at certain points where the arteries approach the body surface. The most common location is where the *radial artery* passes over the distal end of the radius, in each of the upper extremities.

Blood pressure is the force of the blood exerted against the walls of the vessels in which it is contained. Although the term includes the pressure in the arteries, veins, and capillaries, the usual application of the term is to arterial pressure alone. The highest pressure—that is, that produced by the forceful propulsion of the blood through the arteries at each contraction of the ventricle—is known as the *systolic blood pressure*. Under normal conditions in the young adult this pressure is equivalent to about 120 millimeters of mercury, but varies as to age, sex, and condition of arteries and heart. Roughly, systolic blood pressure equals 100 plus the age of the individual. A certain amount of blood pressure is maintained in the arteries during the



FIG. 22.—Valves of a vein. In the lower part of the figure are seen the parietal valves; the upper part shows the mouth of a vein guarded by a valve. (Poirier and Charpy.)

period of cardiac relaxation. This is caused by the elasticity and tonicity of the arteries and by the peripheral resistance. This pressure is known as the *diastolic blood pressure*. In normal young adults it is equivalent to from 70 to 90 millimeters of mercury. The difference between these pressures is called the *pulse pressure*.

The blood vessels.

The *aorta* is the main trunk of the arterial system. (Fig. 23.) Springing from the left ventricle of the heart, the aorta arches over the root of the left lung, descends along the vertebral column, and after passing through the diaphragm into the abdominal cavity, terminates at the level of the fourth lumbar vertebra where it divides into the right and the left common iliac arteries. During its course the aorta is a continuous single trunk, which gradually diminishes in size and gives off branches at various points. The

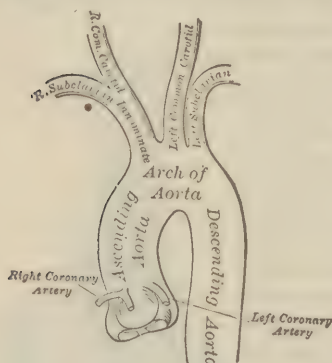


FIG. 23.—Plan of the branches of the arch of the aorta. (Gray.)

aorta may be divided into the *thoracic* (commonly known as the *ascending*, the *arch*, and the *descending*) and the *abdominal* portions.

The *ascending aorta*, a short part contained in the pericardium, gives off two branches, the right and the left *coronary arteries*, which supply the musculature of the heart.

The *arch of the aorta* extends from the ascending aorta, around the root of the left lung, to the border of the fourth thoracic vertebra. During its course it gives off three branches; the *innominate*, the *left common carotid*, and the *left subclavian arteries*.

The *innominate artery* is a short arterial trunk about 2 inches in length. It arises from the right upper surface of the arch of the aorta, and ascends obliquely toward the

right sterno-clavicular articulation where it divides into the *right subclavian* and the *right common carotid arteries*.

The *left common carotid artery* arises at the middle of the upper surface of the aortic arch. The *right* and *left common carotid arteries* ascend obliquely on each side of the neck to the level of the laryngeal prominence where they divide into the *external* and the *internal carotids*. The *external carotid artery* supplies the throat, tongue, face, ears, and the walls of the cranium; the *internal carotid artery* supplies the brain and the eyes.

The *subclavian arteries*, the right passing from the innominate artery and the left from the aortic arch itself, form the first part of the arterial trunks which supply the upper extremities. These arteries give off branches to the back, the chest, the neck, and the brain. The subclavian artery as it passes over the first rib into the axilla is called the *axillary artery*. This vessel gives off branches to the chest, the shoulder, and the arm. The *axillary artery* on passing the armpit becomes the *brachial artery*, which gives off branches to the bone and muscles of the arm, and terminates just below the level of the elbow by dividing into the *ulnar* and the *radial arteries*. The *ulnar artery*, the larger of the two branches extends along the medial side of the forearm to the palm of the hand where it forms the *superficial volar arch*. The *radial artery* extends along the outer side of the forearm to the palm of the hand where it forms the *deep volar arch*. This deep volar arch anastomoses with the superficial volar arch and supplies the hand with blood. (Fig. 24.)

The *descending aorta* extends from the arch of the aorta to the diaphragm and gives off the following branches:

1. The *intercostal arteries* which are paired, 9 or 10 on each side, and supply the intercostal muscles and the adjacent structures.
2. The *superior phrenic arteries*, which are small branches supplying the upper surface of the diaphragm.
3. The *bronchial arteries*, two left and one right, which are the nutrient vessels of the lungs and the bronchi.
4. The *mediastinal arteries* which are numerous small branches supplying the lymph nodes and the areolar tissue of the mediastinum.
5. The *oesophageal arteries*, four or five in number, which anastomose around the oesophagus.
6. The *pericardial arteries*, three or four small vessels distributed to the pericardium.

The *abdominal aorta* begins at the aortic opening in the diaphragm at the lower level of the last thoracic vertebra, and terminates at the level of the fourth lumbar vertebra by dividing into the common iliac arteries. The branches of the abdominal aorta are divided into two groups, those which supply the viscera, the *visceral arteries*, and those which are distributed to the walls of the abdomen, the *parietal arteries*.

The visceral group consist of:

1. The *celiac axis*, a short wide vessel, one-half inch in length, which arises from the front of the aorta just below the diaphragm and divides into three branches; the *gastric*, supplying the stomach; the *hepatic*, supplying the liver, the gall bladder, and the duodenum; and the *splenic*, supplying the spleen and a part of the stomach and the pancreas.
2. The *suprarenal arteries*, right and left, which are distributed to the suprarenal glands.
3. The *superior mesenteric artery* which arises from the front of the aorta just below the suprarenal arteries and supplies the small intestine, except the duodenum and half of the large intestine.
4. The *spermatic arteries* (*ovarian* in female), right and left, which are distributed to the testes (ovaries in the female).
5. The *inferior mesenteric artery* which arises from the front of the aorta about an inch above the bifurcation and is distributed over the lower half of the large intestine and the rectum.

The parietal group includes:

1. The *inferior phrenic arteries*, right and left, which supply the lower surface of the diaphragm.

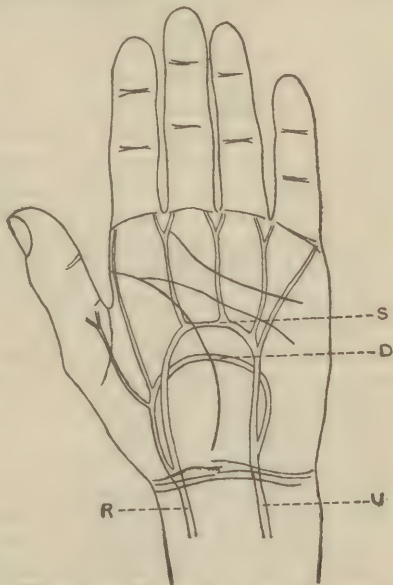


FIG. 24.—Volar arches, left hand: S, Superficial volar arch; D, deep volar arch; U, ulnar artery; R, radial artery. (Gray, modified.)

2. The *lumbar* arteries, usually four pairs, which supply the posterior and lateral abdominal wall and muscles.

3. The *middle sacral* artery, a small vessel which is a direct continuation of the abdominal aorta and supplies the sacrum and coccyx.

The *common iliac* arteries (left and right) begin at the bifurcation of the aorta, extend downward and outward for 2 inches, when they divide into the *hypogastric* and the *external iliac* arteries. The *hypogastric* arteries supply branches to the pelvic walls, the pelvic viscera, the external genitals, and the buttocks. The *external iliac* artery forms the first part of a continuous arterial trunk which supplies the lower extremity and extends to the lower border of the inguinal ligament, where it passes from the abdomen through the femoral opening and becomes the femoral artery. The external iliac artery partially supplies the anterior abdominal wall and the external genitals. The *femoral* artery runs an oblique course around the femur inward and backward in the upper three fourths of the thigh to the posterior surface of the knee joint, where it becomes the *popliteal* artery. The *femoral* artery supplies branches to the muscles, the bone, and the skin of the thigh. The *popliteal* artery, after giving off branches anastomosing around the knee joint, divides into the *anterior* and the *posterior tibial* arteries. The *anterior tibial* artery, the smaller of the two branches, passes forward between the tibia and fibula and then down the front of the leg to the ankle, where it becomes the *dorsalis pedis* artery which supplies the dorsal surface of the foot. The *posterior tibial* artery passes down the back of the leg to the ankle, where it divides into two branches which supply the sole of the foot. It gives off various branches, the largest of which, the *peroneal* artery, also passes to the plantar surface of the foot and supplies some of the muscles and skin of the foot and the ankle joint.

The *veins* begin as small branches called *venules* which unite to form larger vessels. Veins differ from arteries in that they have a larger capacity, thinner walls, and contain valves which assist in supporting the column of blood. This is necessary because most of the cardiac impulse is lost during the course of blood through the capillaries.

The veins are divided into the *pulmonary*, the *systemic*, and the *portal* systems.

It has been shown that the pulmonary arteries end in capillaries about the alveoli of the lungs. After oxygenation blood is collected from these capillaries by the venules which unite to form a vein from each of the five pulmonary lobes. The right lung, however, sends but two veins to the heart as does the left lung, the veins of the superior and the inferior lobes of the right lung uniting. There are, then, four *pulmonary veins* carrying blood from the root of the lungs to the left atrium or auricle of the heart. These are the only veins in the body which carry bright red, arterial, or oxygenated blood.

The *systemic veins* are arranged in two sets, the *deep* and the *superficial*. The deep veins as a rule accompany their corresponding arteries and usually are called by a corresponding name. The large arteries have only one accompanying vein, but the medium sized or smaller arteries have, as a rule, two veins which anastomose freely with each other.

The superficial veins lie just under the skin, where in many localities they may be easily seen. The superficial veins of the lower extremity are the *internal* or *long saphenous* vein, which starts on top of the inner side of the foot and runs up the inner side of the leg and thigh to terminate just below the groin in the *femoral* vein, and the *small saphenous* vein, which starts in

a similar manner on the outer side of the foot and terminates just behind the knee in the *popliteal* vein.

The superficial veins of the forearm and the arm begin from the *dorsal venous arch* and the *volar venous plexus* of the hand. The *cephalic* vein passes up the outer side and the *basilic* vein up the inner side of the forearm and arm and empty into the *axillary vein*, which becomes the *subclavian*. The *median* vein passes up the middle of the forearm and at the level of the elbow terminates by sending a branch to both the cephalic and basilic veins.

The largest veins of the neck are the two *internal jugular* veins. The principal function of these vessels is to return the blood from the brain. They are in close proximity to the common carotid arteries and therefore are deeply seated. They unite with the *subclavian* vein of either side to form the *innominate* veins.

The great superficial veins of the neck are the *external jugular* veins, right and left, which receive the blood from the face and the exterior of the cranium and empty into the right and left subclavian veins.

All of the venous blood from the upper half of the body is carried to the right auricle by the *superior vena cava*, while that from the lower half of the body is carried to the same place by the *inferior vena cava*. The two *venæ cavæ* are joined together by the *vena azygos*, which also collects blood from most of the intercostal spaces.

The portal system is composed of four large veins: The *gastric*, the *splenic*, the *inferior*, and the *superior mesenteric* veins. These vessels collect blood from the intestinal tract, the spleen, and the pancreas. They unite to form the *portal* vein, which enters the liver and divides into capillaries and blood spaces, from which another set of veins, the *hepatic*, arises. The hepatic veins terminate in the inferior vena cava. The purpose of the portal circulation is to subject the blood containing the product of digestion to the special action of the liver before it enters the general circulation.

The *lymph vascular system* is an open system of vessels which form a network throughout the body and connect with serous and tissue spaces. (Fig. 25.) This system also forms certain lymph trunks, the most important of which, the *thoracic duct*, terminates in the left innominate vein. The continuity of lymph vessels is interrupted by interposed *lymph glands*. The lymph glands probably serve in part as filters and as sources of origin of the lymphocytes. The flow of lymph is maintained by means of the difference in pressure in the various tissue spaces and in the large veins of the neck. This is brought about by the muscular movements of the body, and by the differences in intrathoracic pressure during the phases of respiration. The backward flow of the lymph is prevented by the presence of valves which are similar to those found in the veins.

The *thoracic duct* is from 15 to 18 inches long and extends from the level of the second lumbar vertebra to the root of the neck. This vessel is situated just in front of the vertebra and empties into the left innominate vein at its origin. All lymphatic vessels of the body empty into the thoracic duct,



FIG. 25.—Nodes of the inguinal region with the afferent and some of the efferent lymphatics. (Poirier and Charpy.)

except those from the right side of the head, the right upper extremity, and the right chest and its contents, all of which empty into the *right lymphatic duct*. This is a short duct one-half inch in length lying at the root of the neck and emptying into the right innominate vein. This vessel receives the lymph from the above-mentioned regions.

THE RESPIRATORY SYSTEM.

The respiratory apparatus consists of the *nasal chambers*, the *pharynx*, the *larynx*, the *trachea*, the *bronchi*, the *lungs*, and the *pleuræ*. The air entering the nasal chambers, or the mouth, passes through the pharynx, through an opening called the *glottis* into the larynx and from there into the trachea, the

bronchi, and the *alveoli* or air sacs of the lungs. (Fig. 26.)

The *nasal chambers* are irregular wedge-shaped cavities, lined with fine hairs which act as filters and remove dust particles from the inspired air.

The *pharynx*, by virtue of its position between the nasal chambers, the mouth, and the larynx, merely forms a passageway for the air.

The *larynx*, or the organ of voice, is situated in the upper end front part of the neck between the trachea and the base of the tongue. It is a triangular box composed of nine pieces of cartilage which are connected by ligaments. The largest of these cartilages, the *thyroid cartilage*, forms a vertical projection in the midline of the neck. The upper part of this cartilage constitutes the so-called "Adam's apple."

In the interior of the larynx

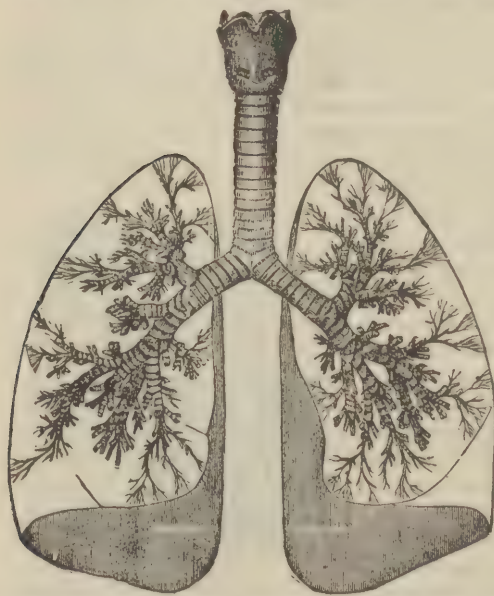


FIG. 26.—The larynx, trachea, right and left bronchi, and the lungs. The latter have been cut open to show the method of division and subdivision of the bronchi. (Mason.)

are located the vocal folds or cords, which aid in the production of voice. The slit between the folds of this organ is called the *glottis*. It is protected by a leaf-shaped lid, the *epiglottis*, which closes over it during the act of swallowing.

The *trachea* is a fibrous muscular tube about $4\frac{1}{2}$ inches long, situated between the larynx and its termination in the right and left bronchi opposite the fifth thoracic vertebra. It lies in front of the oesophagus and is strengthened by about sixteen to twenty C-shaped bars of cartilage. These cartilaginous structures are complete in front and incomplete behind. This serves the purpose of keeping the trachea open. The trachea is lined with *ciliated columnar epithelium*, the movement of which is upward toward the exterior, thus aiding in removing foreign material and secretions from the lungs.

The *bronchi*, right and left, are structures similar to the trachea, with *cartilaginous plaques* instead of bars, each entering into a corresponding

lung. The right bronchus is larger, shorter, and more vertical than the left, so that foreign bodies in the trachea are likely to be directed toward this bronchus. The bronchi divide into small branches similar to a tree, and finally the smallest branches, the *bronchioles*, end in the little sacs, called air vesicles or *alveoli*. These air sacs are very numerous and make up the greater part of the lung substance.

There are two *lungs*. The right lung has three lobes, which are larger, heavier, broader, and shorter than those of the left lung, which has only two lobes. The lungs occupy practically all of the thoracic cavity. They are spongy organs consisting of the alveoli, the bronchial tubes, blood vessels, lymphatics and nerves held together by connective tissue. There are two types of circulation in the lungs, the pulmonary, which brings the blood from the right heart to the lungs for aëration and returns it to the heart, and that from the bronchial branches of the aorta which supply the lung tissue itself. The nerve supply of the lungs is from the pneumogastric nerve and from the sympathetic nervous system.

The *pleura* is a closed serous sac enveloping the lung and lining the thoracic wall. The portion of the pleura which covers the lung is known as the *visceral pleura* and dips into the fissures between the lobes. The pleura is reflected back to line the thoracic wall and is then called the *parietal* or *costal pleura*. Each lung is enveloped in its own pleural sac. These sacs do not communicate with each other, and the potential cavity between the two layers of pleura contains a very small amount of serous fluid which acts as a lubricant during respiratory movements of the lungs. The region between the two pleural sacs in which the remaining thoracic viscera are located is called the *mediastinum*.

The cycle of respiration is divided into three phases:

1. *Inspiration*, or the flow of air into the lungs.
2. *Expiration*, or the flow of air out of the lungs.
3. *A period of rest*.

The cycle is completed about eighteen times per minute in the normal adult while at rest. In the act of inspiration the diaphragm contracts and the ribs are elevated by the accessory muscles of respiration, thus enlarging the thoracic cavity, and creating a negative pressure in the cavity. This permits the lungs to expand and causes the outside air to rush in and equalize the pressure. In expiration the diaphragm relaxes, and the elasticity of the lungs, together with the weight and the elasticity of the chest walls, causes the chest to return to its original size, expelling a certain amount of air from the lungs.

The lungs, when filled to their utmost capacity, hold about 4,500 cubic centimeters of air. Practically 500 cubic centimeters of air is breathed out at a normal quiet expiration. This air which is changed at each respiration is called the *tidal air*. The amount of air breathed out or in may be increased by forceful expiration and inspiration. The amount of air left in the lungs after the most forceful expiration is about 1,000 cubic centimeters and known as the *residual air*. Under normal conditions the reserve supply of air in the lungs is about 2,600 cubic centimeters.

The consensus of opinion is that the automaticity of the respiratory apparatus is under control of the respiratory center which is located in the medulla. This center is in turn dependent on the carbon dioxide content of the blood, an increase of carbon dioxide stimulating the center. The rate of respirations may be controlled, to a certain extent, voluntarily.

Certain sounds are produced by the entry and exit of air from the alveoli of the lungs and the bronchi. These sounds may be variously modified in lung diseases.

Certain abnormal types of breathing may be noted. *Dyspnœa* is labored or difficult breathing. *Apnœa* is a condition in which there is a temporary cessation of breathing. *Asphyxia* is the condition produced by oxygen starvation and is caused by prolonged interference with the aëration of the blood. Many of our emotions, such as sighing, laughing, crying, speaking, or singing produce to some extent modified respiratory movements.

The process of aëration of the blood takes place in the lungs, the inspired air losing a certain amount of oxygen and taking up a certain amount of carbon dioxide. Gases have the property of diffusibility through a semi-permeable membrane; that is, they pass from a medium of a greater density to one of less density. The actual pressure of oxygen in venous blood is less than that of the alveolar air from which it is separated by diffusing through the thin cell layer which lines the capillaries and the alveoli. The reverse holds true of carbon dioxide. (*See above, hæmoglobin.*)

THE DIGESTIVE SYSTEM.

In order to understand the processes concerned with digestion, it is necessary to know the meaning of the various terms used in describing this process.

Digestion is the process or act by which various food products are converted into simpler substances which can be absorbed and assimilated.

Mastication is the division of food into small particles. This is accomplished by means of the teeth.

Insalivation is the mixing of food with the saliva. This takes place within the mouth.

Deglutition or *swallowing* is the act of transferring food from the mouth to the stomach.

Enzymes are complex organic chemical compounds capable of producing, by catalytic action, the transformation of some other compound or compounds.

Absorption, as applied to digestion, means the taking up of digested food products, either in solution or suspension, by the blood and the lymph from the alimentary tract.

Peristalsis is a worm like contraction which passes along the intestinal tract. This movement moves or propels the contents of the intestine.

Defæcation is the term applied to the act of expelling feces from the rectum.

The *digestive system* consists of the *alimentary canal* and the *accessory organs*. (Fig. 27.) The *alimentary*

canal is a continuous tube extending from the mouth to the anus. It is composed of the mouth, the pharynx, the œsophagus, the stomach, and the small and large intestines. The *accessory* organs of digestion are the teeth, the tongue, the salivary glands, the liver, the gall bladder, and the pancreas.

The *mouth* or buccal cavity is nearly oval in shape, and is formed in front by the lips; above, by the hard palate in front, and the soft palate behind; at the sides, by the cheeks; and below or at the floor, by the tongue. This cavity opens posteriorly into the *pharynx* from which it is partially separated by the *anterior pillars of the fauces* and the *uvula* which is a small flap of mucous

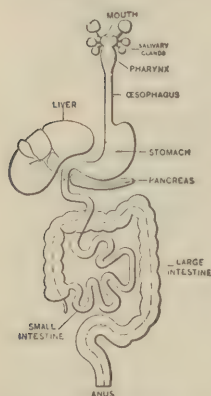


FIG. 27.—Diagram of the alimentary tube and its appendages. (Testut.)

membrane hanging from the soft palate. In the small depression between the anterior and posterior pillars of the fauces, on either side, is a small mass of lymphoid tissue called the *tonsil*. The semicircular borders of the upper and lower jaw bones (the alveolar processes), contain sockets for the reception of the *teeth*. In the adult there are 32 teeth, 16 in each jaw, 4 incisors, 2 cuspids (canines), 4 bicuspids, and 6 molars. The structure of the teeth is described in the section on dental first-aid (p. 110).

The *tongue* is a muscular organ forming the floor of the mouth. It contains the special organs of taste, and assists in speech and in mixing and swallowing the food.

The *salivary glands*, consisting of three pairs, which discharge their secretion, saliva, into the mouth are as follows. The *parotid* glands situated in front of and below the ear, discharge their secretion by way of *Stenson's duct* which enters the mouth opposite the second molar tooth of the upper jaw. The *sub-maxillary glands* lying under the lower jaw, and the *sublingual glands* under the tongue, discharge their secretions via ducts into the floor of the mouth.

The *pharynx* is a funnel-shaped cavity between the mouth and the œsophagus, and communicates with the mouth, nose, larynx, œsophagus, and the ears, the latter by means of the *auditory* or *Eustachian tubes*.

The *œsophagus* is a muscular tube, about 10 inches in length, extending from the pharynx to the stomach, situated practically in the median line but inclining slightly to the left. It rests on the vertebral column and pierces the diaphragm about a half inch above its termination at the cardiac orifice of the stomach. It is composed of three layers, an *inner mucous layer* of squamous epithelium, a middle layer of *submucous connective tissue*, and an outer or *muscular layer* which is composed of involuntary muscle tissue, containing internal circular fibers and external longitudinal fibers.

The *stomach* is a hollow muscular organ, the shape and size of which depends somewhat upon its contents. (Fig. 28.) The capacity of this organ is about five pints in the adult. The stomach has two openings, one at the œsophageal end called the *cardiac orifice*, the other at the intestinal end called the *pylorus*. The upper surface of the stomach is concave and is known as the *lesser curvature*; the lower surface is convex and is called the *greater curvature*. The bay-like cavity formed by the greater curvature is known as the *fundus*, the upper part of which is called the *cardiac end* and the lower part the *pyloric end*. The stomach is composed of three coats—the *outer* or *serous* coat; the *middle* or *muscular* coat, in which the muscular fibers are arranged circularly, obliquely, and longitudinally; and the *inner* or *mucous* coat of columnar epithelial cells. The inner coat is arranged in many folds and contains numerous glands which secrete the gastric juice.

The *intestine* is a musculo-membranous tube about 28 feet long. It begins at the pyloric orifice of the stomach and ends at the *anus*. It is divided into the *small* and the *large intestine*. The small intestine is about 23 feet in length, lies coiled in the abdomen, and is divided into three parts, the first, the *duodenum*, which is about 12 inches long; the second, the *jejunum*, about 9 feet in length; and the third, the *ileum*, about 13 feet in length. The small intestine is made up of three coats—the *outer* or *serous* coat, made up of visceral

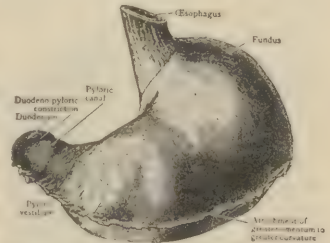


FIG. 28.—The stomach. (Cunningham.)

peritoneum; the *middle* or *muscular* coat, consisting of two layers of involuntary muscle, an outer longitudinal and an inner circular layer; and the *inner* or *mucous* coat. The *mucous* coat is arranged in little folds or elevations called *villi*. (Fig. 29.) On the inner side of these villi are small capillaries and lymphatics which collect the digested food products. There are numerous glands in this inner coat of the intestines. This is especially so in the duodenum, where

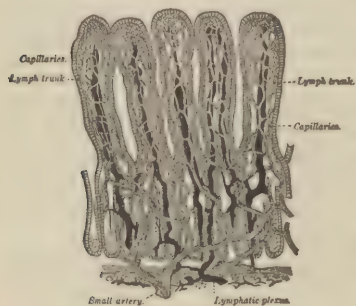


FIG. 29.—Villi of small intestine. (Cadiat.)

intestinal fluids or juices which aid in the digestion of certain foods are secreted. Two ducts from the accessory organs of digestion open into the intestine, the *pancreatic duct* from the pancreas, and the *common bile duct* from the liver and the gall bladder. The wormlike movements of the intestine, called peristalsis, produced by the contraction of the muscular coats, mix the food contained in the intestine with the digestive juices and move the intestinal contents onward. The coats of the large intestine are arranged in the same manner as those of the small intestine, and are of the same structure, except that

the longitudinal muscle fibers of the large intestine are arranged in three bands, which extend the entire length of the colon and are somewhat shorter than the rest of the tube, thus causing the walls to pucker. The mucous coat of the large intestine is smooth and contains no villi, but secretes a mucus which lubricates the tube.

The large intestine has a greater lumen than the small intestine and is divided into the following parts: The *cæcum*; the *ascending colon*, which curves at the lower border of the liver, forming the *hepatic flexure*; the *transverse colon*, which traverses the abdomen to the splenic region, at which place it curves downward, forming the *splenic flexure*; the *descending colon*, which descends to the brim of the pelvis over which it curves to form the *sigmoid flexure*; and the *rectum*, in which the feces are retained until they are expelled at intervals by the voluntary act of defecation. At the union of the ileum with the cæcum two folds of mucous membrane form the *ileocæcal valve*. This valve prevents regurgitation of the contents of the large into the small intestine. At the blind end of the cæcum is a small wormlike projection called the *vermiform appendix*.

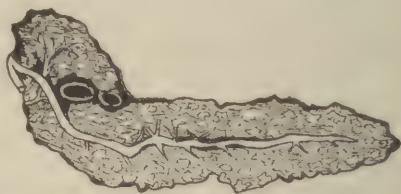


FIG. 30.—Pancreas. (Mason.)

The *pancreas* is a prismatic shaped gland about 10 inches long, presenting three surfaces of nearly equal width ($1\frac{1}{4}$ inches). (Fig. 30.) It is situated behind the stomach at about the level of the second lumbar vertebra. It has a *head*, a *body*, and a *tail*. Its head is surrounded by the duodenum, into which the pancreatic duct discharges. The pancreas is a compound gland containing a certain amount of interglandular or connective tissue. In this connective tissue are small areas of modified glandular tissue having no ducts. These are called the *islands of Langerhans*. They discharge their secretion directly into the blood stream and are considered to have some influence in the metabolism of sugar, and also upon the activities of the other glands of internal secretion.

Absence of these islands or disease of the pancreas involving them causes a disease known as *diabetes mellitus*.

The *liver* is the largest gland in the body and weighs from 50 to 60 ounces in the normal adult. (Fig. 31.) This organ measures 8 to 9 inches from side to side, 4 to 5 inches perpendicularly, and 6 to 7 inches from front to back. It is placed directly under the diaphragm in the right side of the abdominal cavity, and is held in position by ligaments which are formed by the peritoneum. The liver is divided into five lobes by five fissures, the largest of which is the *transverse fissure*, through which the vessels, ducts, and nerves enter and leave the organ. The liver has a double blood supply. One blood supply is from the hepatic artery of the systemic circulation, and the other is from the portal vein carrying absorbed food material from the intestine. The drainage for both sets of capillaries is the hepatic vein which empties into the inferior vena cava. The liver is made up of many minute lobules of liver cells arranged concentrically about a central vein, which is a small venule of the hepatic vein. The lobules are held together by connective tissue which contains the capillaries of the hepatic artery and the portal vein, as well as the bile ducts. It is to be seen that the blood from these vessels must come in close association with the liver cells in order to reach the central venule. In the *gall-bladder fissure* on the lower surface of the liver is the *gall bladder*, a small muscular pear-shaped sac about 3 to 4 inches long which serves as a reservoir for the bile.

The *bile* is partly an excretion which carries off certain waste products, and partly a digestive secretion. Bile is manufactured in the liver cells and is collected by the *biliary ducts* which unite to form the *hepatic duct*. The hepatic duct is joined by the duct from the gall bladder and forms the *common bile duct* which opens into the duodenum. The bile is formed more or less continually but enters the intestines only during periods of digestion. It is prevented from entering the intestines at other times because of the fact that the orifice of the common bile duct is closed except during digestion. The bile at these times is stored up in the gall bladder. Bile is a golden yellow or dark olive colored fluid, mildly alkaline, and is secreted normally in amounts of from 500 to 800 cubic centimeters per day. As an excretion the bile removes certain waste products of metabolism such as disintegrated liver cells and the bile pigments; as a digestive secretion it aids in the digestion in the preparation of fats for absorption. Bile is considered to limit to a certain extent putrefactive action in the intestines.

The functions of the liver are important and numerous and are as follows:

1. *Bile secreting*.—It manufactures and secretes bile.
2. *Glycogenic*.—It manufactures glycogen from monosaccharides brought to the liver from the digestive tract by the portal vein. Glycogen is stored in the liver and is reconverted into dextrose by the action of a special enzyme at such times as body activities require it.
3. *Storing of fat*.—A certain amount of fat may be stored within the liver cells.
4. *Urea producing*.—Takes up nitrogenous waste products from the blood and converts them into urea, which is discharged back into the blood stream for elimination by the kidneys.

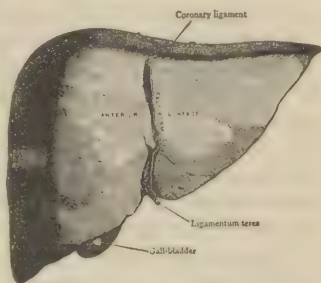


FIG. 31.—The liver. (Cunningham.)

5. *Removes* by means of the bile certain other waste products, such as broken-down red corpuscles and bile pigments.

6. The *liver* is considered by some authorities as the source of fibrinogen and prothrombin. This organ is the site of origin of blood cells in the embryo.

The *peritoneum* is a serous membrane lining the abdominal cavity and is reflected onto the various organs contained therein. It completely covers some of these organs and only partially covers certain others. It is lubricated by a small amount of serous liquid, the *peritoneal fluid*, thus making a smooth surface for the free movement of the intestines. Parts of the duodenum, the colon, the bladder, and the kidneys are not covered by peritoneum; the remaining principal abdominal organs are completely surrounded by this membrane. Numerous folds of the peritoneum extend between the various organs and serve to connect them with the posterior wall of the abdomen and with one another, such as the various ligaments of the liver and the *mesentery* which holds the intestines in place and contains the vessels which supply them. The *omentum*, an apron-like structure composed of four layers of peritoneum with enclosed fat, is pendant from the transverse colon, and is freely movable. It is of service in walling off inflammations or infections within the abdominal cavity.

In the process of digestion, food is taken into the mouth, finely divided by mastication and mixed with the saliva. The *saliva* is a colorless or opalescent, viscid liquid of slightly alkaline reaction which contains two digestive enzymes. These *enzymes*, active in alkaline media, are the *ptyalin* which converts starches to *maltose* and *dextrin*; and the *maltase* which breaks up maltose into *dextrose*. From the mouth the food, by the act of swallowing or deglutition, passes into the œsophagus, through which it is carried into the stomach, where it is thoroughly mixed, by the movements of the stomach wall, with the gastric juice to form chyme. *Chyme* is the thick liquid mass into which the food is converted by gastric digestion.

The *gastric juice* is a thin colorless or nearly colorless liquid having a strongly acid reaction. It is secreted by the glands within the mucous coating of the stomach, contains *hydrochloric acid*, and three enzymes, *pepsin*, *rennin*, and *lipase*. The food on mixing with the gastric juice becomes acid in reaction. The *hydrochloric acid* destroys the ptyalin, aids in coagulating the proteins, and also activates the *proteolytic enzyme*, *pepsin*, which is secreted in an inactive form, *pepsinogen*. *Pepsin* acts on the proteins of the food breaking them into simpler compounds known as *peptones* and *proteoses*. This action is preparatory to more complete digestion in the intestines. *Rennin* acts upon the soluble protein of milk, *caseinogen*, to form a curd or *casein*. *Lipase* is a fat-splitting enzyme, present in only a small quantity, and has very little activity. The period required for gastric digestion is dependent upon the type of food taken, the average time being about five hours. The ejection of chyme through the pylorus occurs at regular intervals and depends on the activity, the consistency, and the acidity of the chyme. Hydrochloric acid in the stomach seems to favor relaxation of the pyloric sphincter, which remains closed after each ejection until the acidity in the duodenum is neutralized. Absorption in the stomach is limited to small amounts of liquids, soluble substances such as salts, and simple sugars such as may have resulted from salivary digestion.

In the duodenum the chyme becomes mixed with the intestinal juices secreted by glands in the mucous membrane of the duodenum, the pancreatic juice, and the bile. The intestinal juice is alkaline in reaction and contains four enzymes, which take up and complete the unfinished work of the gastric and the pancreatic juices. Three of these are sugar-splitting enzymes

and the fourth a proteolytic enzyme. Their activities are illustrated by the following table:

Enzyme.	Acting on—	End products.
<i>Invertin</i>	Cane sugar.....	Dextrose and levulose.
<i>Maltase</i>	Malt sugar.....	Dextrose and dextrin.
<i>Lactase</i>	Milk sugar.....	Galactose and levulose.
<i>Erepsin</i>	Peptones and proteoses.....	Amino acids.

The *pancreatic juice* is a thin, limpid liquid, slightly alkaline in reaction. Its secretion is started as soon as the chyme passes the pylorus. The pancreatic juice contains three enzymes: *trypsin*, a proteolytic ferment; *amyllopsin*, a starch-splitting ferment; and *steapsin*, a fat-splitting enzyme. Trypsin, like pepsin, is secreted in an inactive form, *trypsinogen*, and must be activated by a *hormone* called *enterokinase* which is present in the intestinal juices. Tabularly the activities of pancreatic enzymes are represented as follows:

Enzyme.	Acting on—	End products.
<i>Trypsin</i>	Proteins and peptones.....	Amino acids.
<i>Amylopsin</i>	Starches.....	Dextrin and maltose.
<i>Steapsin</i>	Fats.....	Fatty acid and glycerin.

The action of steapsin in breaking down and saponifying fats is aided and facilitated by the presence of bile.

While all digestive juices are added to food by the time it leaves the duodenum, digestion and absorption continue throughout practically the whole of the intestinal tract, although the greatest part takes place in the small intestine. *Absorption* takes place by two paths, (1) by the *capillaries of the villi* to the blood stream, and (2) by the *lymphatics* to the thoracic duct and the superior vena cava. The fats in their emulsified and saponified form are absorbed chiefly by the lymphatic vessels or the lacteals. The products of protein digestion, chiefly amino acids, and of carbohydrate digestion, chiefly monosaccharides, are absorbed by the *blood stream*, and are carried to the liver by the portal vein. In the liver the excess sugar is withdrawn and stored as glycogen, the amount of sugar in the blood remaining constant. A small amount of fat is absorbed by the capillaries, part of which is appropriated by the liver for its own use and for storage.

There is a small amount of food absorption and a marked absorption of water from the large intestine. This rapid loss of water gives the *fæces* their consistency at the time the intestinal contents reach the rectum.

SPLEEN AND DUCTLESS GLANDS.

The *spleen* is situated directly below the diaphragm behind and to the left of the stomach. It is bean shaped, convex on the outer surface, and weighs usually from 5 to 8 ounces. It is dark purplish in color, and is composed of a fibrous capsule filled with a pulpy mass of lymphoid cells. This organ is well supplied with blood, and has the peculiarity that when the minute arteriole stage is reached the blood escapes into the spleen pulp and is collected by the small venules, the capillary system being absent. Its functions are not definitely known, but it is supposed to be concerned with the production of lymphocytes both in the embryo and in the new born. The spleen may be

involved in certain other metabolic processes, as the production of hæmoglobin, the manufacture of uric acid from certain protein waste products, and as an aid to digestion in the production of an activating substance for certain enzymes.

The *ductless glands* are secretory epithelial structures having no ducts, and produce an internal secretion which is filtered directly into the blood or the lymph stream. The principal ductless glands are the *thyroid*, the *parathyroids*, the *thymus*, the *suprarenals*, and the *pituitary* and the *pineal bodies*. Some of the typical glands, as the pancreas, and the testicles (ovaries in the female) have ducts, and yet contain certain interstitial structure which discharge an internal secretion into the blood stream.

The *thyroid gland* is a highly vascular body situated on the sides of the trachea at its junction with the larynx and extends upward on each side of the larynx. It consists of two *lateral lobes* connected across the middle line by a narrow transverse band called the *isthmus*. The internal structure consists of vesicles of different sizes, lined with a single layer of epithelial cells and containing a colloid material. The thyroid forms a substance containing a large percentage of iodine and having certain influences on metabolic and nervous activities. Complete thyroidectomy or removal of the thyroid, leaving the parathyroids uninjured, is usually followed by a state of chronic malnutrition or *cachexia*. *Cretinism* is the result of a congenital defect or atrophy of the thyroid gland, which causes the arrest of skeletal and mental development. On atrophy of this gland in the adult, a similar phenomenon called *myxœdema* results, the body becomes puffed and pasty, and the mentality blunted. In *hyperthyroidism* there is an extreme nervousness, increased metabolism, quickened heart action, and in some cases protrusion of the eyeballs (*exophthalmos*).

The *parathyroids* are four small bodies of epithelioid tissue situated on or near the posterior surface of the lateral lobes of the thyroid, two on each side. They furnish an internal secretion which aids in neutralizing certain toxic substances. It is known that on complete removal of the parathyroids, death results from acute tetany.

The *thymus gland* consists of two lobes, situated on each side of the midline in the upper thorax extending, at the time of maximum development, from the fourth costal cartilage to the lower border of the thyroid gland. This gland is considered to reach its maximum size in childhood, and while it undergoes atrophy after puberty it does not entirely disappear. Its function is obscure, but it is believed to have a definite effect on the growth of the body and the development of the reproductive organs. Removal or atrophy of the gland causes precocious sexual characteristics.

The *suprarenal* or *adrenal glands* are two flattened, irregular masses situated extraperitoneally in the back part of the abdomen, just above and in front of the kidneys. The average size of the glands is about 2 inches by 2 inches, and one-fourth of an inch thick. These glands consist of a highly vascular central mass of chromophil tissue, the *medulla*, enclosed within a *capsule of cortical substance*, which is in turn enclosed by a *fibrous capsule*. The *medulla* secretes *adrenalin* (*epinephrin*) which exerts a marked influence on the tone of the blood vessels and the heart. It increases blood pressure by causing contraction of the blood vessels and slowing and increasing the force of the heart beat. It also seems to increase the hydrolysis of glycogen, producing an increase of sugar in the blood stream, and has some effect on the skeletal muscles by lessening their tendency to fatigue. The function of the *cortex* of this gland is not definitely known, but it is supposed to neutralize certain toxins and to manufacture a lipid element necessary in all cellular structures. In Addison's

disease the gland is involved causing a deficiency of secretion, and producing symptoms of great prostration with loss of tone of the musculature and of the organs of circulation.

The *pituitary body* or *hypophysis* is a small gland attached to the base of the brain by a pedicle and situated in a depression in the sphenoid bone. It is composed of an *anterior lobe* and a *posterior lobe* to which a glandular portion, the *pars intermedia*, is closely adherent. The anterior portion is glandular, while the posterior portion is composed of neuroglia cells and fibers. The internal secretion of the anterior lobe seems to have an effect on the body growth, conditions of the gland such as tumors or hyperplasia producing the symptoms of *gigantism*, *acromegaly*, and *precocious sexual development*. A decrease in the secretion of this gland over a continued length of time produces the opposite effect, and complete suppression of the secretion results in death. The secretion of the posterior lobe, inclusive of the *pars intermedia*, acts as a stimulant to the involuntary muscles, increases blood pressure, slows the heart beat, stimulates certain glands to greater activity as the kidney and mammary glands, and acts on sugar metabolism in a way similar to the adrenal secretion.

The *pineal body* or the *epiphysis*, is a small gland projecting from the roof of the third ventricle of the brain. It reaches its greatest growth about the seventh year, after which time the glandular structure degenerates, and is replaced by connective tissue. Its secretion seems to have the effect of inhibiting growth and restraining the development of the sexual organs.

THE EXCRETIONS.

Excretions are waste products resulting from the activities of the body, and are discharged to the exterior by means of several organs. The excretory organs are as follows :

The *urinary system*, which eliminates water, and certain organic and inorganic waste products; the *skin*, which eliminates water, organic and inorganic waste materials by means of perspiration; the *lungs*, which eliminate certain gaseous waste products, i. e., carbon dioxide, water vapor, and small amounts of ammonia; and the *alimentary tract*, which eliminates the residue remaining after digestion, and the products discharged into it, such as bile.

The *urine* in man is usually yellowish in color and acid in reaction. The reaction, however, depends upon the character of the individual's food. It has an average specific gravity of about 1.020. The average daily output of urine is about 40 to 50 ounces, depending upon many factors, such as the temperature of the atmosphere and the ingestion of liquids. Urine is composed of about 95 per cent of water and 5 per cent of soluble organic and inorganic salts. The greater part of the organic substances are nitrogenous waste end products of protein metabolism. Urea forms about 2 per cent of the total solids, and other nitrogen compounds are present in minor quantities. The remaining solids are made up of inorganic salts of sodium, calcium, ammonium, potassium, and magnesium. Certain abnormal constituents as albumin, sugar, indican, acetone, casts, and blood may be found under pathological conditions.

The *sweat*, or *perspiration*, excreted by the sweat glands of the skin, is a watery, turbid liquid, with a salty taste and a distinctive rancid odor. It has an alkaline reaction. Normally about 1 quart of this fluid is excreted daily, but the amount varies widely with the temperature of the atmosphere, the humidity, and the amount of exercise taken. The sweat consists chiefly of water with small quantities of salts, fatty acids, urea, and carbon dioxide.

The skin.

The *skin* is a tough elastic membrane forming the outer covering of the body, and contains certain appendages as the hair and nails. Certain glands, as the sweat and the sebaceous glands, discharge their secretions upon the surface of the skin. (Fig. 32.)

The skin is made up of two layers, the *epidermis*, or *cuticle*, and the *derma*, or *true skin*. The *epidermis* consists of stratified squamous epithelium, the superficial layer being horny and hard, and the inner layer known as the *germinative layer* consisting of soft protoplasmic cells.

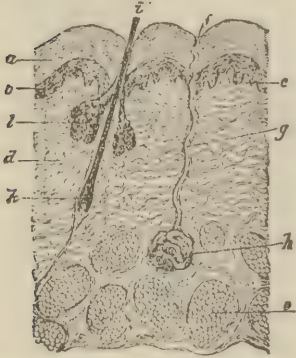


FIG. 32.—Perpendicular section of the skin, showing: *a*, The epidermis, cuticle, or scarf skin; *b*, layer of dark-colored cells; *c*, the papillæ on the surface of *d*, the corium, derma, cutis vera or true skin, and *e*, the fat cells underlying it; *f*, a perspiratory pore or aperture; *g*, the duct, and *h*, the coiled substance of a sudoriparous gland; *i*, the shaft of a hair; *k*, its root, and *l*, sebaceous glands communicating with the interior of the hair follicle. (Mason.)

The *derma* is a highly sensitive and vascular layer of connective tissue, in which is found blood vessels, hair follicles, sweat and sebaceous glands, and nerve endings.

The *sweat glands* are coiled tubular glands, the coil of which lies embedded in the derma and surrounds a small tuft of capillaries. These glands are located in the subcutaneous tissue and open by a duct upon the surface of the skin. The sweat glands serve as excretory organs, excreting the sweat or perspiration. The *sebaceous glands* are compound sacular glands, the ducts of which open about the hair shaft. These glands secrete an oily substance, *sebum*, which keeps the skin soft and pliable. The true skin is well supplied with specialized nerve endings which carry impressions of touch, heat, cold, and pain. The true skin also contains motor nerves to blood vessels, and secretory nerve fibers to the glands.

The skin serves as a protective covering to aid in the preservation of body temperature, and as an excretory organ. It contains the special nerve fibers mentioned in the above photograph.

The urinary system.

The urinary system consists of the *kidneys*, the *ureters*, the *bladder*, and the *urethra*. (Fig. 33.)

The kidneys, two in number, are located at the back of the abdominal cavity, behind the peritoneum, one on each side of the spinal column, and extend from the level of the twelfth thoracic to that of the third lumbar vertebrae. The right kidney is slightly lower than the left. These organs are bean shaped, and each kidney is about 4 inches long, 2 inches wide, and 1½ inches thick. Each is surrounded by a thin fibrous capsule and lies embedded in a mass of extraperitoneal fat. The kidney substance consists of an outer third, the *cortex*, and an inner two-thirds, the *medulla* which surrounds a funnel shaped cavity, and the *pelvis*. Fig. 34.) The *cortex* of the kidney is made up of cuboidal epithelial cells lining either convoluted or straight tubules, and thousands of small structures known as the *Malpighian bodies* or *renal corpuscles*. These bodies are made up of small tufts of capillaries called the *glomeruli*, which are invested by a small membranous sac inverted over them except at the point where a small blood vessel enters and leaves the capillary tuft. This

capsule forms a beginning of the *uriniferous tubule* which is lined with secretory cells and is continued as the *primary convoluted tubule*. The latter are straight tubules, which enter and pass through the medulla of the kidney and discharge the urine into the kidney pelvis. The blood supply of the kidneys is maintained through the renal artery and the venous return is via the renal vein. These vessels enter and leave the depression on the inner border of the kidney known as the *hilus*. The generally accepted theory of secretion of urine

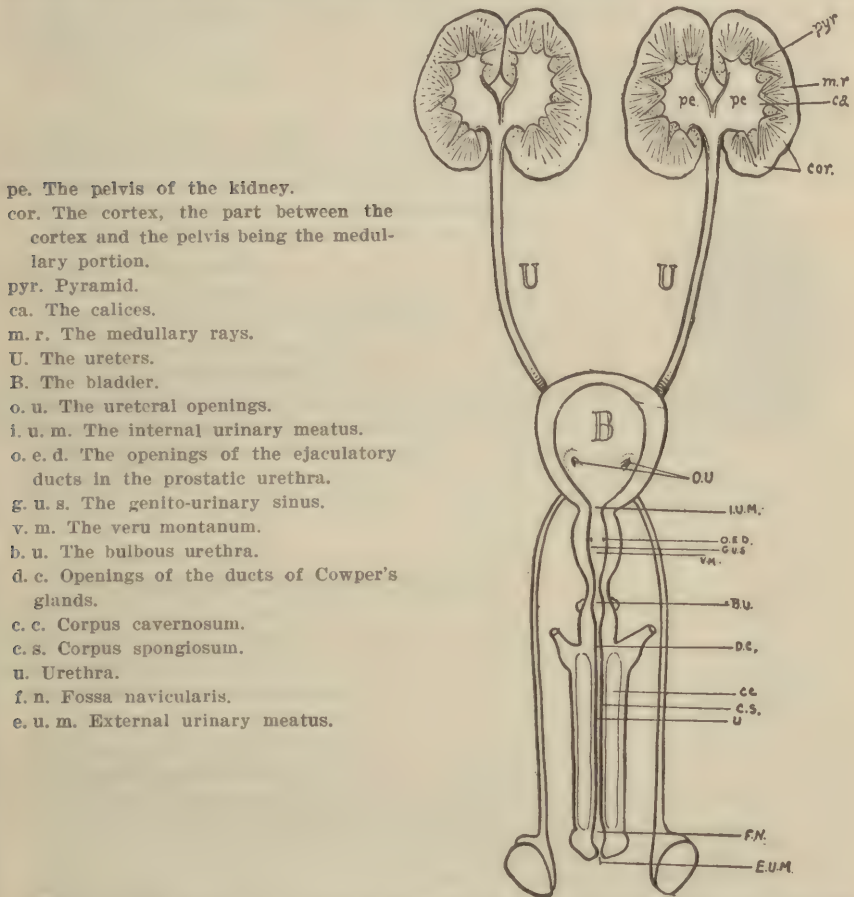


FIG. 33.—Anterior view of the opened genito-urinary tract in the male. (Guiteras.)

is that it is a combination of the processes of filtration and secretion, the water and soluble mineral salts filtering through the capsule of the glomeruli, and the organic constituents, such as urea and uric acid, being secreted by the cells lining the tubules.

The *ureters* are two musculo-membranous tubes about the size of a goose quill in diameter and about 15 inches long. They connect the pelvis of the kidney and the bladder, leaving the kidney at the hilus and entering the bladder at the lower and back portion of the organ, where they deliver to the bladder the excretion of the kidneys. The course of the ureters is obliquely through the muscular walls of the bladder, so that when the bladder is

distended the coats of the ureters are approximated in such a manner that regurgitation or urine from the bladder is prevented.

The *urinary bladder* is a musculo-membranous sac situated in the pelvis just behind the pubis, and does not, under normal conditions, extend above the upper border of the symphysis. It acts as a reservoir for urine until such time as micturition is convenient. When moderately distended the bladder holds about 1 pint. Upon the inner surface of the bladder in the upper part or fundus the mucous membrane is thrown into folds or *rugæ*. The lower portion presents a comparatively smooth triangular surface, known as the *vesical trigone*, outlined by the openings of the two ureters and the urethra.

Micturition or the act of voiding urine is an involuntary mechanism controlled partly by volition.

The *urethra* is a membranous tube passing from the bladder along the under surface of the penis to the distal end of that organ where it terminates in the *meatus*. It serves to convey the urine, and, in the male, the secretions of the genital glands to the exterior. It is about 8 inches long, and is divided into three parts, the prostatic, the membranous, and the penile portions. The prostatic urethra, about 1 inch in length, is surrounded by the prostate gland and contains the orifices of the prostatic and the ejaculatory ducts. In this portion the lumen of the urethra is the largest. The membranous urethra is about one-half inch in length and consists of that portion which pierces the urogenital diaphragm. The penile urethra is the longest portion and lies along the base of the penis, extending to its external opening, the urinary meatus. (See section on Venereal Diseases.)



FIG. 34.—The kidney on section. (Guiterras.) 1. Capsule. 2. Pyramids of Malpighi. 3. Columns of Bertini. 4. Renal artery. 5. Same, its posterior branch. 6. Same, its anterior branch. 7. Peripyramidal arteries. 8. Renal pelvis. 9. Ureter.

THE MALE GENITAL ORGANS.

The male genital organs consist of the *testes*, the *epididymis*, the *scrotum*, *ductus deferens*, *seminal vesicles*, *prostate gland*, *bulbo-urethral glands*, *urethra*, and the *penis*.

The *testes* are two glandular organs suspended from the inguinal region by the *spermatic cord* and surrounded and supported by a musculo-membranous sac, the *scrotum*. The *testicle* proper is ovoid in shape and is composed of tubular glands held together by connective tissue. These gland cells form the male generative cell, the *spermatozoa*. The interstitial cells of the testis have an internal secretion which promotes the development of masculine characteristics. The tubules of the testicle unite to form a long tortuous tube which lies along its posterior surface and connects with the *ductus deferens*. This tube or body is called the *epididymis*.

The *ductus deferens* (*vas deferens*) is the excretory duct of the testicle and runs in the spermatic cord through the inguinal canal into the abdomen, thence extra-peritoneally on a convergent course to the *seminal vesicles*. The *spermatic cord* forms the pedicle of each testicle and extends from the internal abdominal ring to the back of the testis, and is made up of the ductus deferens, spermatic arteries and veins, lymphatics, nerves, cremasteric muscle and fascia.

The *seminal vesicles* are two glandular pouches between the bladder and rectum, and unite with the ductus deferens to form the *ejaculatory duct*.

These vesicles serve as a reservoir for the *semen* and add a secretion of their own. The ejaculatory ducts pass from the seminal vesicles between the lobes of the prostate gland and open into the floor of the prostatic urethra.

The *prostate gland* surrounds the first portion of the urethra, and resembles a horse-chestnut in form. The glandular and muscle tissue of this gland is surrounded by a dense fibrous capsule. The gland secretes a fluid which is an essential element of the semen. The *bulbo-urethral* glands are two small bodies about the size of a pea situated one on each side of the membranous urethra and opening into it. These glands secrete a fluid which forms part of the seminal fluid.

The *penis* consists of three more or less cylindrical bodies of *erectile tissue*. The two *corpora cavernosa* lie above the *corpus spongiosum* which contains the urethra. The *glans penis*, forming the distal end of the penis, is continuous with the corpus spongiosum and contains the external opening of the urethra, the *meatus*. The covering of the shaft of the penis is loose skin, but that portion reflected over the glans penis is a thin layer of skin lined with mucous membrane, and is called the *prepuce*.

THE NERVOUS SYSTEM.

The nervous system frequently is termed "the ruler of the body." "Its first great work is to cause all parts of the body to work harmoniously together. Its second is to act as the organ of the mind."

The nervous system is divided into the *cerebro-spinal system* and the *sympathetic or ganglionic system*. The *cerebrospinal system* consists of the brain and the cranial nerves, and the spinal cord and its nerves. The *sympathetic or ganglionic system* consists of double chains of ganglia or collections of nerve matter situated on either side of the vertebræ and extending from the skull to the pelvis. In addition there are several groups or collections of disconnected ganglia, situated in the abdomen, which supply the internal organs and the walls of blood vessels with their nerve influence. A collection of these nerve ganglia is called a *plexus*; for example, the cardiac plexus supplying the heart, the solar plexus supplying the stomach, the pulmonary the lungs, and the hypogastric the organs in that region of the body.

Nerve tissue is either cellular or fibrous tissue. The *cellular* tissue is gray in color and is found in the brain, spinal cord, and all nerve centers. The *fibrous* tissue is either gray or white in color. The gray fibers are found in the sympathetic or ganglionic system and the white chiefly in the brain and spinal cord.

A *nerve* is a whitish colored cord-like substance which conveys impulses from one part of the body to another. The nervous system is made up of numerous small nerve cells.

Nerve cells or *neurons* vary in size and shape and possess one or more processes, one of which is called the *axone* or *axis cylinder process* because it becomes the axis cylinder of a nerve fiber; the others are called *dendrites* or *protoplasmic processes*. (Fig. 35.) Nerve cells are grouped as unipolar, bipolar, and multipolar, according to the number of processes they possess.



FIG. 35.—Motor nerve cell.
(Howell.)

A *nerve center* is any group of cells of gray nerve substance having a common function. It has the power to generate, receive, and transmit impulses. A nerve can only conduct the impulse generated in a nerve center.

A *motor nerve* is one whose function is to produce motion. A *sensory nerve* is one by means of which pain, hunger, sensations, etc., are felt. A *vaso-motor nerve* is one which conveys impressions of either contraction or dilatation to the vascular system. A *mixed nerve* is one which contains both motor and sensory fibers. An *afferent nerve* is one which conducts impressions to a nerve center only.

White nerve substance or *nerve-fiber* contains two kinds of fibers, the medullated or white and the nonmedullated or gray.

The *medullated fibers* contain a central core or axis cylinder which is surrounded by a *medullary sheath* or *white substance of Schwann*, composed of fatty matter in a fluid state which protects the axis cylinder. This medullary sheath is enclosed in a sheath called the *neurilemma*. These medullated fibers

compose the white matter of the nervous system and are found in the brain, spinal cord, ganglia, and in nerve trunks distributed to all parts of the body. Nerves are supplied by a very minute system of capillary blood vessels.

The *nonmedullated fibers*, called the gray or gelatinous nerve-fibers, consist of an axis cylinder which is enclosed in a nucleated sheath. These fibers constitute most of the sympathetic nervous system and include some of the cerebrospinal system, forming the gray matter of the brain and the spinal cord.

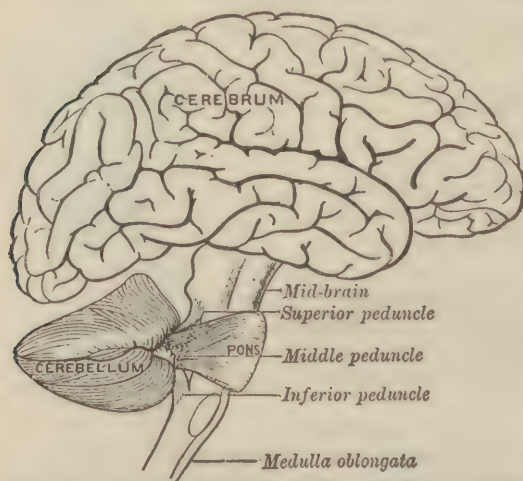


FIG. 36.—Scheme showing the connection of the several parts of the brain. (Gray.)

The *brain*, the largest and the most complex mass of nervous tissue in the body is contained in the cavity formed by the bones of the cranium. It is covered by three membranes, or *meninges*, the *dura mater*, the *pia mater* and the *arachnoid*.

The *dura mater*, a dense membrane of fibrous connective tissue, contains many blood vessels and is arranged in two layers, except in a few places. The outer layer of the *dura mater* is adherent to the inside surfaces of the bones of the skull where it forms their periosteum. The inner layer covers the brain and sends numerous prolongations inward for the support and protection of the lobes of the brain. These projections form the sinuses of the brain through which the blood is returned from the brain to the large veins of the neck. They also form the sheath for the nerves leaving the cranial cavity.

The *pia mater*, a delicate membrane of connective tissue containing a network of blood and lymph vessels, lies under the *dura mater* and extends to all crevices and depressions of the brain. It contains the blood vessels of the brain and supplies blood to all parts of the brain. It frequently is called the nutritive membrane.

The *arachnoid*, a delicate serous membrane, lies between the *dura mater* and the *pia mater*. Except in the longitudinal fissure of the brain this membrane does not dip down into the crevices and depressions of the brain. Between the *arachnoid* and the *pia mater* is a space called the *subarachnoid space*, in which is found a certain amount of cerebro-spinal fluid.

The *brain* itself is divided into three main parts: The *forebrain*, containing the cerebral hemispheres and other bodies; the *midbrain*, a short, constricted portion connecting the pons and cerebellum with the forebrain; and the *hind-brain*, consisting of the medulla oblongata, pons, and cerebellum. (Fig. 36.) The *pons Varolii* consists of two rope-like bundles running from the cerebellum to form a broad mass in the midline of the cranial cavity, and its fibers join the two hemispheres of the cerebellum and connect the medulla with the cerebrum.

The *cerebrum*, the largest part of the brain, fills the whole of the upper part of the cavity of the skull. It is composed of gray matter externally which is the active part of the brain and white matter internally in which are embedded masses of gray matter. The outer portion of the cerebrum is made up of alternate elevations called *convolutions* and depressions called *fissures*. Some of these fissures occur at an early age in fetal development and divide the hemispheres into lobes which bear names corresponding to the cranial bones near which they lie.

The *great longitudinal fissure* extends from the front to the back of the cerebrum and completely divides it into two hemispheres, which are connected by a broad transverse band of white fibers called the *corpus collosum*. The *transverse fissure* separates the cerebrum from the cerebellum. The fissures of the brain divide each hemisphere into sections called lobes. These lobes are (1) *frontal lobe*, (2) *parietal lobe*, (3) *temporal lobe*, (4) *occipital lobe*, and (5) the *central lobe* or the Island of Reil. Among the important fissures are the fissure of Rolando, called the *central sulcus* running from the top and near the middle of each hemisphere downward and forward for two-thirds of its vertical measurement and separating the *frontal lobe* from the *parietal lobe*; the *lateral cerebral fissure* (Fissure of Sylvius), dividing the *frontal* and *parietal lobes* from the *temporal lobe*; and the *parieto-occipital* fissure separating the *parietal* from the *occipital lobe*.

The function of the cerebrum is to govern all of the mental activities and coordinate body movements. This section of the brain contains the centers or seats of reason, intelligence, will, memory, and all of the higher emotions and feelings. Certain areas of the brain have a preponderance of control over certain functions, although all areas are more or less closely connected by association fibers. For instance, the frontal lobe is primarily the seat of reasoning or higher psychological thought, that portion just anterior to the central fissure is the motor area, the temporal lobe is the seat of hearing, and the occipital lobe is the seat of vision.

The white matter consists of fibers which run in three directions (1) from above downward, (2) from the front backward, and (3) from side to side. They form a connection between the different parts of the brain and connect the brain with the spinal cord.

The interior part of the brain contains cavities called *ventricles* which communicate with the cavity of the spinal cord and contain small amounts of cerebrospinal fluid.

The *cerebellum* lies in the posterior and inferior part of the skull cavity between the occipital lobes of the cerebrum above and the medulla oblongata below. This part of the brain is divided into a middle segment called the *vermis* and two lateral lobes or hemispheres which are subdivided by fissures

into smaller convolutions. The surface of the cerebellum consists of gray matter, the interior of white matter. The principle function of the cerebellum is to coordinate ordinary movements and to maintain equilibrium.

The *medulla oblongata* is continuous with the spinal cord which, as it enters the cranium through the foramen magnum, becomes a widened oblong-shaped mass. It rests on a groove in the occipital bone, and forms the floor of a cavity between the two hemispheres of the cerebellum. It is hollow, and contains the expanded continuation of the spinal canal, which is called the *fourth ventricle* of the brain. The surface of the medulla contains several fissures which form

convolutions. The functions of the medulla are similar to those of the spinal cord, namely, conduction, reflex action and automatic action. Its function of conduction is important as it conducts all impressions passing between the brain and the spinal cord. The important reflex centers contained in the medulla are: (1) The respiratory center for regulating the function of respiration, (2) the accelerator centers for the heart, (3) the vasomotor center.

The *spinal cord* is that part of the central nerve system which lies in the spinal canal, extending from the medulla oblongata to the first lumbar vertebra. (Fig. 37.) At the first lumbar vertebra the spinal cord gives off a number of fibers, which continue in the spinal canal to form a tail-like expansion called the *cauda equina*. The three coats or membranes which cover the brain extend down and cover the spinal cord. The subarachnoid space between the arachnoid and the pia mater is likewise continued and contains a fluid called the cerebrospinal fluid, which serves as a protection to the brain and the spinal cord. Between the dura mater and the vertebral column is a protective covering of fatty tissue which also serves as a protection to the spinal cord.

The spinal cord does not fit tightly in the spinal canal, thus permitting movement of the vertebræ. It tapers from above down-



FIG. 37.—Spinal cord and nerves.
(Mason.)

ward. It can be said roughly to be from 16 to 20 inches long and three-fourths of an inch in thickness.

Two fissures, the *ventro-median fissure* anteriorly and the *dorso-median fissure* posteriorly, almost completely divide the spinal cord, leaving only a narrow bridge of substance connecting the two halves. The bridge is called the *isthmus of the spinal cord* and contains a minute central cavity or canal which traverses the entire cord and communicates with the cavity of the brain.

The spinal cord is made up of white matter surrounding an H-shaped section of gray matter. The anterior parts or horns of this H-shaped substance are short and bulky while the posterior ones are long and slender. (Fig. 38.) The white matter of the cord is composed of medullated nerves, the gray of cell

bodies, dendrites, axones, and collateral branches held together by neuroglia. In the spinal cord the nerve fibers lie in bundles, which are called tracts or columns. The function of these tracts is to transmit sensory impressions to and motor impressions from the brain.

The cerebral or cranial nerves.

The *cerebral* or *cranial* nerves, consisting of 12 pairs, originate in the brain and supply certain definite areas of the body. They are of three varieties, (1) sensory nerves, (2) motor nerves, and (3) mixed nerves which contain both sensory and motor nerve fibers. These cranial nerves after leaving the cranium through the definite anatomical exits split up into branches and are widely distributed. They are numbered from before backward in the order in which they arise from the brain, and are named in accordance with their nature, function, or distribution.

The number, name, type, distribution, and function of these cranial nerves is given below.

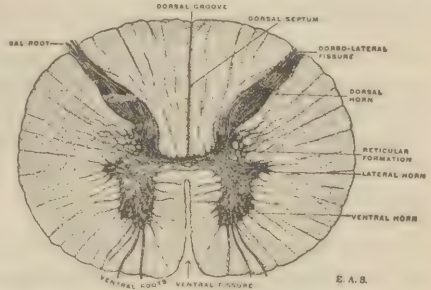


FIG. 38.—Transsection of the spinal cord at the midthoracic region. (Gray.)

Nerve No.	Nerve name.	Type.	Distribution.	Function.
1	Olfactory.....	Sensory.	Upper third of the nasal cavity..	Sense of smell.
2	Optic.....	do.	Retina of eye.....	Sight.
3	Oculomotor.....	Motor...	All eye muscles except superior oblique and external rectus.	Movements of eye.
4	Trochlear.....	do.	Superior oblique muscle of eye..	Do.
5	Trigeminal.....	Mixed...	Skin of face, eyeball, lachrymal glands, mucous lining of mouth and pharynx, teeth, and tongue, muscles of mastication.	Taste, mastication, secretion, and touch.
6	Abducens.....	Motor...	External rectus muscle of eye...	Movements of eye.
7	Facial.....	do.	All muscles of expression of face; also supplies ear and part of neck.	Facial expression.
8	Auditory.....	Sensory.	Internal ear.....	Hearing and equilibrium.
9	Glossopharyngeal.	Mixed...	Tongue and pharynx.....	Taste, movement of pharyngeal muscles and sensation to mucous membrane of pharynx.
10	Pneumogastric....	do.	Larynx, trachea, lungs, heart, pharynx, oesophagus, and stomach.	Both motor and sensory to lungs and larynx. Cardio-inhibitory. Motor to oesophagus and stomach.
11	Spinal accessory...	Motor...	Certain neck muscles.....	Movements of head.
12	Hypoglossal.....	do.	Tongue.....	Movements of tongue.

The spinal nerves.

These nerves, 31 pairs in number, having their origin in the spinal cord by two roots, pass from the vertebral canal through the intervertebral foramina and are distributed to the various parts of the body. There are 8 spinal nerves in the cervical, 12 in the thoracic, 5 in the lumbar and 6 in the pelvic region. The anterior roots of the spinal nerves are the motor roots, the posterior, the sensory roots. Thus all of these nerves are mixed nerves; that is, they carry both sensory and motor impressions. After leaving the intraspinal cavity these nerves split up into two divisions, the posterior divi-

sion supplying the muscles and the integument of the back as individual nerves, the anterior divisions uniting to form plexuses from which the nerve supply to the extremities and other parts of the body is derived.

The sympathetic nervous system.

The function of the sympathetic nervous system is to maintain control over the visceral activities of the body. Most of the functions of this system are performed unconsciously. The viscera are under the control of this system and of the central nervous system. The impulses to the viscera from the central nervous system are distributed through the sympathetic nervous system.

Nerve action.

The basis of all functional activity of the nervous system is the so-called *reflex action*. Nerve fibers which carry impulses away from the nerve centers

are called *efferent* or *motor neurones* (from the Latin *ef-fere*, to bear away). Those which carry impulses to the nerve centers are called *afferent* or *sensory neurones* (from the Latin *afferre*, to bear toward). A *receptor* is any mechanism through which external forces can give rise to nerve impulses. Thus the end of a sensory nerve is called a receptor ending.

"A *reflex act* is one which is executed in response to an external stimulus." It is an unconscious act, and does not require attention, as closing the eyelids to prevent foreign objects from entering the eye.

The following are essential in reflex actions: (1) There must

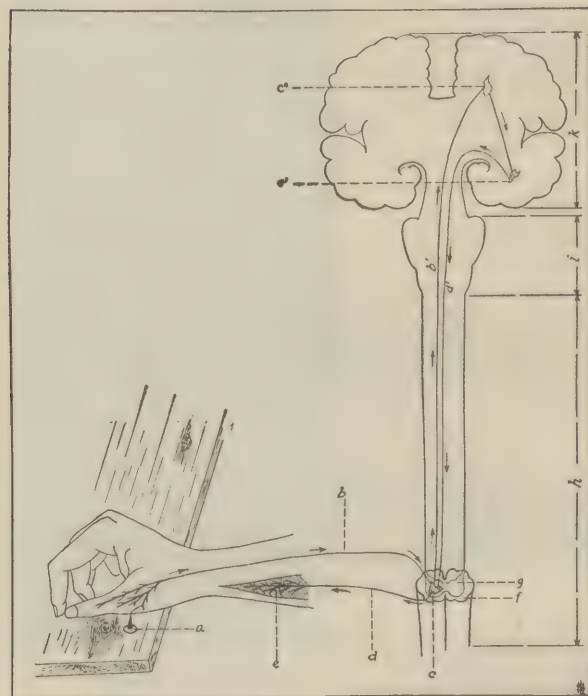


FIG. 39.—Diagram of reflex action: *a*, Tack pricking hand; *b, b'*, afferent nerves; *c, c', c''*, nerve cells; *d, d'*, efferent nerves; *e*, muscle moving hand; *f*, white matter; *g*, gray matter; *h*, spinal cord; *i*, medulla oblongata; *k*, brain.

be a receptor on which the stimulus is brought to bear. (2) There must be a path to the central nervous system, the afferent or sensory neurones by which the sensory impulse is carried. (3) There must be a path from the central nervous system, the efferent or motor neurones by which the motor impulse is carried.

A reflex action takes place by an impulse, generated at the receptor ending of a nerve, traveling up the sensory (afferent) neurones to the central nervous system, through the cell body, traveling down the motor (efferent) neurones to the muscles or gland cells, where the action is produced.

The impulses or reflex actions may be sent to and received from the brain. However, it is believed that in most cases the sensory impulses are received in the spinal cord and the motor impulses originated therein. (Fig. 39.)

Thus, in response to impulses received over the afferent or sensory neurones, the nerve cells in the spinal cord send out orders without waiting for the impulse to be sent to the brain or central nervous system and the orders to be sent out from there. As an example, the hand is pricked by a tack. The receptor nerve ending receives the sensation and the afferent or sensory neurones carry it to the spinal cord and brain. Before the sensation has reached the brain, however, an order to lift the hand has been originated by the nerve cells in the cord and sent out by the efferent or motor neurones. The hand is moved and the brain made conscious of the prick at about the same time.

Reflexes are classed as *simple reflexes*, in which a single muscle or gland is involved as in the corneal reflex; *complex reflexes* in which several muscles or glands are involved, the action remaining perfectly coordinated, as in the patellar reflexes; *spreading reflexes* in which a large number of muscles are involved; *tonic reflexes* or continuous reflexes in which a reaction is repeated a number of times, as in swallowing, coughing, hiccupping, etc.; and *association or perception reflexes* in which a mental picture produces reaction, as in the flow of saliva or gastric juice when well-cooked food is seen or smelled, or when one person yawning causes others to do likewise.

Special senses.

The *special senses* may be classified broadly as *sight, hearing, smell, taste, and touch*.

The *visual apparatus* consists of the *eyeballs*, the *optic nerves*, and the *visual centers* in the brain, together with certain associated organs, as the *eyelids*, *eyebrows*, *muscles of the eyeball*, and the *lachrymal apparatus*.

The *eyelids* are two thin movable folds projecting from above and below, placed in front of the eye. They are covered externally by skin, and internally by a mucous membrane, the *conjunctiva*. This internal lining, the conjunctiva, is reflected over the front of the eyeball. The interior of the eyelid is composed chiefly of connective tissue, part of which is dense fibrous tissue which forms the *tarsal cartilage*. Several small glands, the *Meibomian glands*, are situated in this connective tissue. The upper eyelid contains a small muscle which acts to elevate or lower it. On the margin of each lid are double or triple rows of short hairs or cilia called the *eyelashes*. The function of the eyelids is to afford protection to the eyes. They are movable shades which may exclude light, dust, and other injurious substances.

The *lachrymal apparatus* consists of the *lachrymal glands*, the *canaliculi*, the *lachrymal sac*, and the *nasal duct*. The *lachrymal gland* is situated at the upper and outer angle of the orbit and secretes tears which flow to the surface of the conjunctiva via several small ducts. This secretion passes over the eyeball and is collected by the *canaliculi* at the inner angle of the conjunctiva. These canaliculi communicate with the *lachrymal sac* from which the tears are discharged into the nose through the nasal ducts.

The *orbits* are bony cavities in which the eyeball and its muscles are contained. They are shaped like a four-sided pyramid and are made up of seven bones, the *zygomatic*, *maxilla*, *palate*, *ethmoid*, *frontal*, *sphenoid*, and *lachrymal*. The orbit contains two openings posteriorly, the *optic foramen* for the passage of the optic nerve and the ophthalmic artery; and the *sphenoidal fissure* for passage of the ophthalmic vein and nerves to the muscles of the eye.

There are six extrinsic muscles of the eye the function of which is to move the eyeball. These are the four *recti muscles*, the *internal*, the *external*, the *superior*, and the *inferior*, and the two *oblique muscles*, the *inferior* and the *superior*. (Fig. 40.) The innervation of these muscles has been shown under the cranial nerves.

The eyeball is made up of three distinct coats or layers. (Fig. 41.) The *outer layer* consists of the sclera and the cornea. The *sclera* or "the white of the eye" is a dense, tough, fibrous membrane covering the posterior five-sixths of the eyeball and pierced posteriorly by the optic nerve. In front where the light enters the eye the sclera changes to a transparent membrane having no blood vessels, which covers the remaining one-sixth of the eyeball and is known as the *cornea*.

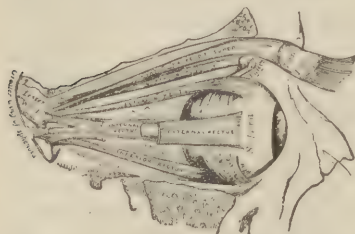


FIG. 40.—Muscles of the right orbit.
(Gray.)

The *middle layer* is composed of the *choroid* and the *iris*. The *choroid* is a thin, vascular, chocolate-colored membrane lining the sclera and containing a network of blood vessels and pierced in the back by the optic nerve. It is folded inward and arranged in radiating folds about the lens of the eye. These folds form the *ciliary processes* and are well supplied with nerves and blood vessels and the *ciliary muscle* is contained therein. The *iris* is a thin, circular, contractile disk directly back of the cornea and suspended in front of the lens but not in contact with it, and perforated near its center by a circular opening called the *pupil*. It divides the space between the cornea and the lens into an *anterior* and *posterior chamber* which contain a watery substance called the *aqueous humor*. The iris is composed of connective tissue, pigment cells, blood vessels, and contains two sets of muscles. One set of muscle fibers contracts the pupil, the other dilates it. The function of the iris is to regulate the amount of light entering the eye—by contracting it decreases the amount of light entering, by dilating it increases it.

The *inner layer* of the eye is the *retina*, which is essentially the expanded fibers of the optic nerve. It is the screen on which the images fall, is most essential to vision, and is a transparent, purplish-colored membrane situated between the inner surface of the choroid and the outer surface of the *vitreous body*, a transparent jellylike substance nearly filling the cavity of the eyeball and separated from the retina by the *hyaloid membrane*. The retina consists of eight layers of cells, the most important of which is the first or external layer called "layer of rods and cones," which acts as end organs to the optic nerve.

The *crystalline lens* is a solid transparent body enclosed in a transparent capsule or membrane and held in place by a ligament. It is situated between the iris in front and the vitreous body behind. The lens is an elastic body which

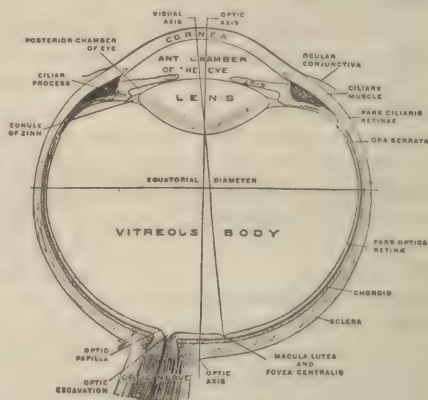


FIG. 41.—The right eye in horizontal section.
(Toldt.)

hardens and loses its elasticity with age. It is kept normally tense by the pull of the suspensory ligament on the capsule. When the eye is adjusted for near vision, the ciliary muscle contracts, drawing the choroid forward, relaxing the suspensory ligament and allowing the lens to change its shape. This is called *accommodation*.

Common defects of accommodation are:

1. *Hypermetropia*, or farsightedness, a condition in which the focal point for near objects is behind the retina.

2. *Myopia*, or nearsightedness, a condition in which the rays are brought to a focal point before the retina is reached.

3. *Presbyopia*, a condition similar to hypermetropia, found in old age and due to loss of elasticity of the lens.

4. *Astigmatism*, a condition in which the curvature of the cornea or lens is defective, causing a dispersion of rays and a blurring of the image.

The *ear* or the *organ of hearing* is composed of three parts: The *external*, the *middle*, and the *internal ear*. (Fig. 42.) The *external ear* consists of the *auricle* and the *external auditory canal*, which extends from the outside to the *eardrum*, or *tympanic membrane*. This membrane separates the external from the middle ear.

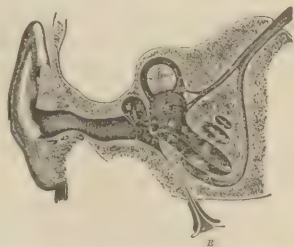


FIG. 42.—Section through right, external, middle, and internal ear. (Howell.)

The *middle ear* is a small, irregular cavity located in the temporal bone. It communicates with the pharynx by the Eustachian or auditory tube and also with the mastoid portion of the temporal bone. The middle ear is separated from the internal ear by a thin bony plate containing two small openings which are covered with a thin membrane. Within the middle ear are the *ear ossicles* or ear bones. (Fig. 43.) These form a chain and extend from the eardrum to the *fenestrum ovale* of the internal ear. The fenestrum ovale is the connection between the middle and the internal ear. The *internal ear* contains the perceptive organ of hearing. It consists of a *bony labyrinth* hollowed out of the temporal bone. This labyrinth is lined with a membrane which contains a fluid called *endolymph* and is divided into the *vestibule*, the *semicircular canals*, and the *cochlea*. The semicircular canals and vestibule



FIG. 43.—The bones of the middle ear: M, Malleus; I, incus; S, stapes. (Howell.)

receive nerve endings from the vestibular branch of the auditory nerve and have to do with the sensation of equilibrium.

The end organs of hearing are located in the cochlea. Hearing is accomplished by sound waves which strike against the eardrum and are transmitted by the ear ossicles to the endolymph of the internal ear, the movement of which stimulates the end organs of hearing. The center of hearing is in the temporal lobes of the brain.

The *sense of smell* is accomplished by emanations of certain substances coming in contact with special nerve endings of the olfactory nerve which are distributed to the mucous membrane of the upper part of the nasal chamber.

Taste is accomplished by certain end organs known as *taste buds*, which are groups of modified epithelium cells of the tongue around which terminate nerve fibers. The perceptive portions of the tongue are the tip, the borders and the posterior portion of the dorsum. The nerves concerned with the sense of taste are the *chorda tympani* of the facial, the *lingual branch* of the trigeminal,

and the *glossopharyngeal*. The center of taste is considered to be in the hippocampal lobe of the brain. There are four fundamental tastes; *salt, sweet, acid, and bitter*. The pleasing variations which commonly are called taste are usually combinations of taste and smell. It is necessary for a substance to be in solution to stimulate taste buds.

Certain special functions and activities.

Speech, or the *expression of coherent thought* is brought about by a combination of several acts under control of a certain brain center. The center of speech is considered to be located deep in the left temporal lobe of the brain. The larynx contains two *vocal folds* controlled by muscles which separate or bring these folds together according to the pitch of tone desired. When air is forced from the lungs past these folds certain sounds are produced, and in conjunction with the movements of the pharynx, tongue, lips, and cheeks articulate speech results.

Sleep is a period of more or less unconsciousness, during which most of the higher psychical powers are quiescent, but during which the physiological activities continue. It usually is considered a period of rest, in which the *constructive processes* exceed the *disassimilatory or catabolic changes*. Certain changes take place during sleep; respiration is slowed, the pulse slowed, and less blood is sent to the brain and greater amounts to the extremities. The cause and necessity for definite periods of sleep is not thoroughly understood.

Heat regulation, or maintenance of constant body temperature is a two-sided process, and consists of controlling the loss of heat as well as the production of heat. Heat is lost through the excreta, through expired air, by evaporation of sweat, and by radiation and conduction from the skin. Heat is produced by physiological oxidations within the body. This is effected by muscular exercises and partly by the variety and quantity of food.

The preservation or elimination of heat is controlled chiefly by the sympathetic nervous system, by nerves to sweat glands and vasomotor nerves. An increase of blood to the skin, increases the loss of heat by radiation. The opposite effect may be produced by vasoconstriction or decrease of blood to the skin.

Fever is an abnormal condition of increased temperature, the exact cause of which is unknown. Generally it is considered to be a metabolic disturbance caused by certain toxic substances which act upon a possible heat center in the brain and influence the sympathetic nervous system.

REFERENCES.

- Anatomy.—Gray.
Text Book of Anatomy.—Cunningham.
Human Anatomy.—Piersol.

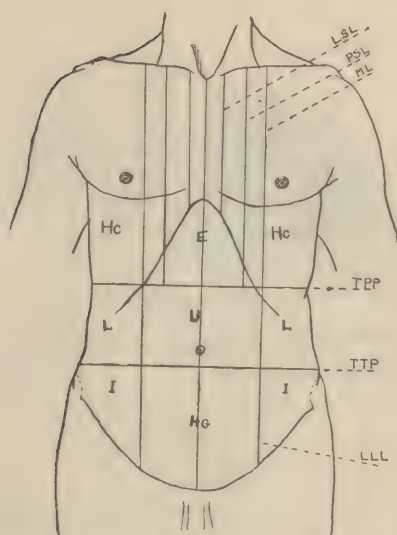


FIG. 44.—Surface markings of front of thorax and abdomen. (Gray, modified.) LSL, Lateral sternal line; PSL, parasternal line; ML, mammary line; TPP, transpyloric plane; TTP, transtuberular plane; LLL, left lateral line; Hc, hypochondriac region; E, epigastric region; L, lumbar region; U, umbilical region; I, inguinal region; HG, hypogastric region

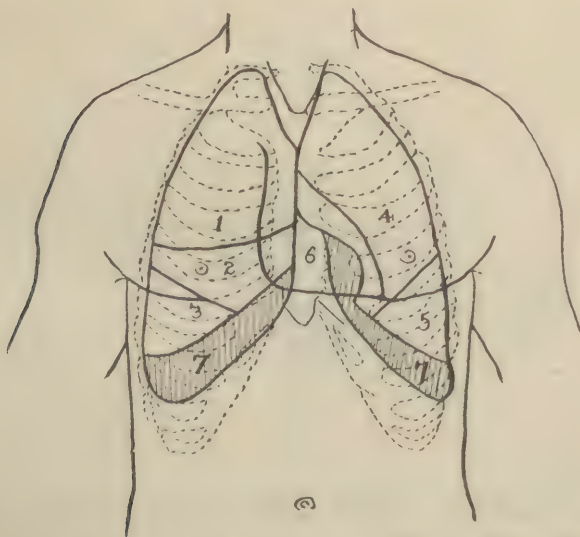


FIG. 45.—Surface markings of heart (6); pleura (7); left lung, upper lobe (4), lower lobe (5); right lung, upper lobe (1), middle lobe (2), lower lobe (3). (Gray, modified.)

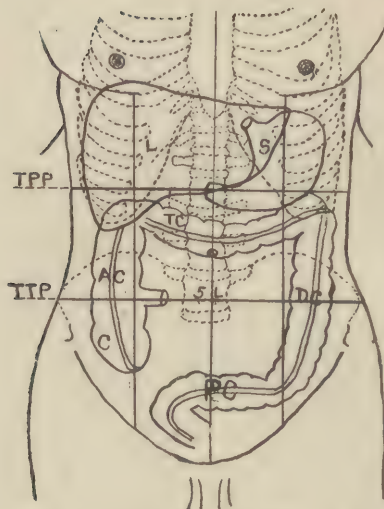


FIG. 46.—Surface markings of front of abdomen. (Gray, modified.) L, Liver; S, stomach; C, caecum; AC, ascending colon; TC, transverse colon; DC, descending colon; PC, pelvic colon; 5L, fifth lumbar vertebra; TPP, transpyloric plane; TTP, transtubercular plane.

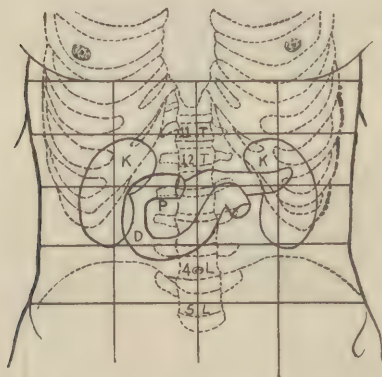


FIG. 47.—Surface markings of front of abdomen. (Gray, modified.) D, Duodenum; P, pancreas; K, kidneys; 11T, 12T, eleventh and twelfth thoracic vertebrae; 4L, 5L, fourth and fifth lumbar vertebrae.

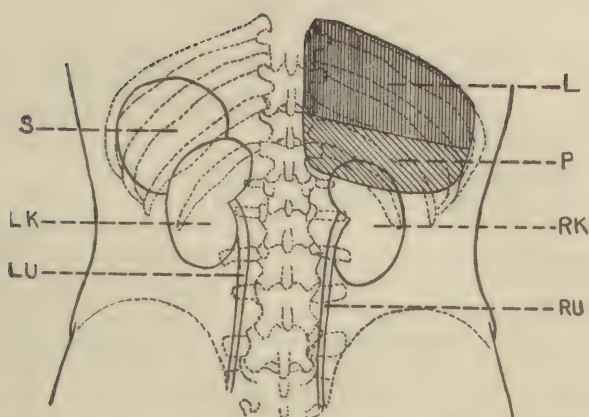


FIG. 48.—Surface markings of back of lumbar region. (Gray, modified.) L, Portion of right lung; P, portion of right pleura; RK, right kidney; RU, right ureter; LU, left ureter; LK, left kidney; S, spleen.

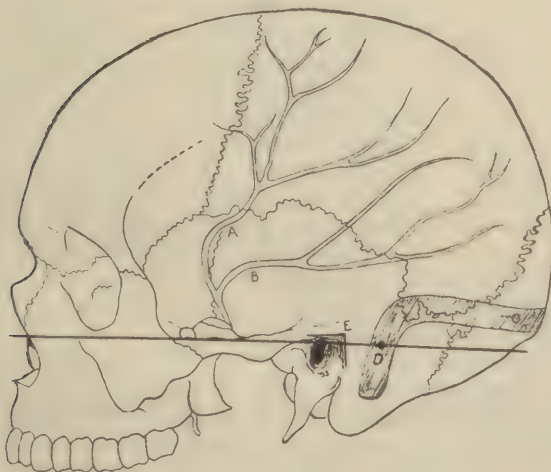


FIG. 49.—Relations of the middle meningeal artery to the surface of the skull. (Gray, modified.) A, Anterior branch; B, posterior branch; C, lateral sinus; D, sigmoid sinus; E, suprameatal triangle.

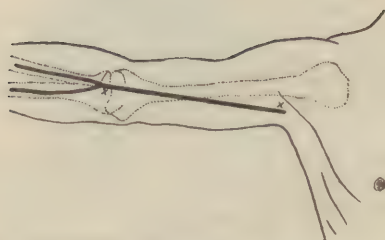


FIG. 50.—Front of right upper extremity, showing surface markings of brachial artery, x x. (Gray, modified.)



FIG. 51.—Front of right thigh, showing surface markings of inguinal (Poupart's) ligament (A A); hypogastric (internal iliac) artery (B B); and femoral artery (x x). (Gray, modified.)

CHAPTER III.

FIRST AID AND MINOR SURGERY.¹

First aid is that which is done for the injured and ill in cases of emergency ; it should neither supersede nor take the place of proper medical or surgical attention and should consist of furnishing temporary assistance to a sufferer pending the arrival of medical aid. The most important fact to remember in first-aid treatment is to summon a medical officer or some one capable of rendering the proper treatment. A hospital corpsman giving first aid should do so with evident display of self-assurance and authority born of knowledge, with decision, calmness, alacrity, and alertness of mind, thus obtaining the confidence of the patient and of interested bystanders.

INFLAMMATION.

Inflammation may be described as the changes which occur in living tissue when it is injured, providing that the injury is not of such a degree as tends to destroy the structure and vitality of the patient. When tissue is injured, the following changes take place : Engorgement of the blood capillaries in the injured tissue and a seepage through the dilated capillary walls of blood fluids and blood cells, particularly white blood cells (phagocytes). Nature brings about these changes with the object in view of bringing aid of a reparative and a nutritive nature to the cells which make up the tissue injured. Inflammation manifests itself by certain local signs and symptoms which are produced by changes in the injured tissue. These symptoms are heat, pain, discoloration, swelling, and disordered function of the part involved. Heat and discoloration are due to the enlargement of the blood capillaries, the swelling to the throwing out of blood fluids and cells into the injured tissues, and the pain to the pressure of pent-up fluids on the nerve ends in the area affected. The constitutional symptoms, increase of temperature and increase of white blood cells (leucocytosis), depend in a large measure upon the cause of the inflammation and the absorption into the general circulation of the broken-down products of this inflammation.

The causes of inflammation are : *Traumatic*, such as blows and mechanical irritation ; *chemical*, such as stings of insects, mustard, venom of serpents, ivy poisoning, etc. ; *thermal*, heat and cold ; *microörganisms*, such as staphylococcus, streptococcus, etc. ; and *agencies*, such as electricity, X-rays, actinic rays of the sun, etc.

The main general principles involved in the *treatment* of inflammations are : (1) To remove the exciting cause ; (2) to keep the inflamed part at rest ; and (3) to reduce the local blood pressure by elevation of the part.

Other agencies employed in the treatment of inflammation are heat and cold, wet dressings, and ointments. Heat acts by softening the tissues and hastening the carrying away of the products of inflammation, thus decreasing the pressure on the nerve ends in the inflamed area. Cold acts by contracting

¹ Prepared by Lieut. Commander R. H. Laning, Medical Corps, United States Navy.

the dilated blood capillaries and thus decreasing tension. Wet dressings and ointments act by softening the tissues and frequently contain some agent to rid the inflamed area of the specific cause of the inflammation—some micro-organism, for instance.

The conditions in which inflammation plays a very important part are: Fractures, dislocations, sprains, strains, wounds, burns, frostbite, and many kinds of infection.

Inflammation due to microorganisms or bacteria differs from inflammation due to other causes in that the cause of septic inflammation, or inflammation due to bacteria, is a living organism which multiplies and throws off poisons in increasing quantities until such time as the white blood cells and blood fluids thrown out from the dilated capillaries can overpower it. In the case of aseptic inflammation the cause is other than bacterial.

The principal danger in a septic inflammation is that the white blood cells and blood fluids will not be able to overcome the microorganisms which may gain access to the circulation and set up areas of inflammation elsewhere in the body. The term applied in this condition is *sepsis*.

Bacteria which cause infection or sepsis are present in myriads on the surface of our bodies and on every article we touch, unless it has been sterilized. Our skin and mucous membranes protect us from infection and sepsis, and it is only when there is a break in these tissues that the bacteria of sepsis gain entrance and start septic inflammation. All bacteria of infection and sepsis do not cause the same degree of inflammation, some causing mild and others very severe inflammation. In the case of some it is easy for blood fluids and white blood cells to limit the inflammation locally, while with others it is difficult for them to do so.

An *abscess* is a localized area of infective inflammation containing live and dead microorganisms, live and dead phagocytes (white blood cells which have been combating the microorganisms), fluids forced out from the blood capillaries, and the broken-down products of dead tissue cells. The content of an abscess is called *pus*.

The *treatment* of an abscess is in accordance with the rules for treating other inflammations, but with the added rule that the *pus when formed must be evacuated*. Abscesses should be incised and drainage instituted, in order to reduce pressure on the tissues, rid the tissue of the irritating products of infective inflammation, and lessen the chances of the infecting organism gaining access to the general circulation and causing further troubles. Strict care must be taken not to introduce further infective organisms when the incision is made; that is, an aseptic technique must be employed. The incision must be large enough to allow good drainage. Never squeeze the abscess, as this tends to break down nature's barrier and to spread the infection. Depending on the severity of the inflammation, more or less of this tissue may die, and this dead tissue is spoken of as *slough*. When the slough includes the skin or mucuous membrane, an *ulcer* results.

A *boil* or *furuncle* is an abscess in the true skin in which the infecting micro-organism generally gains access by way of a sebaceous or sweat gland, and in which there is a small slough in or beneath the true skin.

A *carbuncle* is a boil or furuncle in which there are multiple sloughs often coalescing in one beneath the true skin. When the pus from these sloughs finds its way to the surface an opening occurs, hence the numerous foci of pointing (coming to a head). While one incision is sufficient for an ordinary boil or furuncle, numerous incisions are required in a carbuncle on account of the extensive area of the infective inflammation and resulting slough. Carbuncles

are very dangerous, particularly about the face on account of the danger of spread of the infection to other parts of the body, and a patient suffering from one should be brought immediately under the care of a medical officer. If a furuncle breaks, one opening results; if a carbuncle breaks, numerous openings result. Diabetes, Bright's disease, and conditions of lowered resistance brought about by living in impure air, on improper foods, etc., render an individual particularly susceptible to boils. Boils and furuncles may be treated by nicking the surface of the skin in the shape of a cross (+) (crucial incision) over the area in which the pointing will take place and then applying a Bier's cup. This method relieves the pain and soreness almost immediately.

SHOCK.

Shock is a sudden interference with the vital activities of the body controlled by the nervous system, which may be likened to a system of electric wiring. If too heavy a current is made to traverse these wires, they are likely to be burned out, or the fuses blown. In the same way, if too violent impulses traverse the nerve paths in our bodies, there may be death from complete nonfunctioning of the nervous system, or there may result a much milder condition in which there is only partial functioning of the same. As the nervous system controls all the vital activities, so in shock all the vital functions are more or less affected. Practically any impulse traversing the nerve paths, if severe enough, may cause shock. There is *emotional shock*, where the impulses originate in the brain; *traumatic shock* from a severe blow in the solar plexus or testicle, or from crushing or cutting of a large nerve trunk; or *electrical shock* from a heavy electric current traversing the nerve paths. One of the main effects of too violent impulses on the nerve track is the loss of nerve control over the blood vessels, resulting in the circulating blood collecting in the veins, especially the large veins of the abdomen and depriving the brain and other parts of the body of their supply. More or less shock occurs from all injuries. Depending upon the stability of the nervous systems of individuals, what might cause a mild case of shock in one could cause a severe case in another.

Symptoms.

A person suffering from severe shock lies in a drowsy condition, with the limbs limp, but generally is not totally unconscious. The skin is pale and cold; the temperature is subnormal; the pulse is feeble, fluttering, and rapid, and may be irregular and barely perceptible; the respirations are shallow and sighing; the pupils are generally dilated. Great thirst is frequently an accompaniment of shock.

The sensibility of these patients often is lowered and they do not feel pain as acutely as in a normal condition. Shock may result in immediate death from heart failure, or a condition known as *reaction* may be established. This state frequently is ushered in by vomiting and is characterized by a gradual return of color to the skin and a rise of body temperature accompanied by an improvement in the heart's action and fuller and deeper respirations. After reaction is established, it is not unusual for the patient to fall into a sound sleep. In a case of mild shock, there may be nothing more than momentary paleness, weakness, and perhaps some temporary confusion of the thought. Other names applied to condition of shock are faintness and collapse.

Concealed hemorrhage resembles shock very closely, and always must be kept in mind in all cases of severe shock.

Treatment.

The principle underlying the treatment of shock is to bring the blood which has accumulated in the large abdominal veins back into the general circulation, to bring the proper blood supply back to the brain where the vital centers are situated and to the surface of the body, and to administer proper stimulation. If the shock is at all severe, a medical officer should be summoned immediately, but treatment must be started at once without waiting for his arrival. This may be accomplished by placing the patient in the proper position, applying warmth and administering stimulants. The position in which the shocked person is to be placed is on the back with the head low in order that the blood will tend to run into the brain. A good way to do this is to raise the foot of the bed or bench on which lying. Never raise the head of a shocked person by placing it on a pillow. The application of warmth acts as a stimulant, and also tends to bring the blood to the surface of the body. Warmth should be applied both externally and internally. Externally, warmth is applied by friction and rubbing of legs and arms briskly toward the trunk, by putting the patient on a bed in a warm room, covering with blankets and surrounding with hot water bags, hot bricks or stones. Care must be taken that the latter are properly covered and not so hot as to burn the patient. Loss of body heat always increases shock; therefore, never remove more clothing than necessary from a shocked person, and when possible spread blankets or coats over him. Be careful, while rubbing, that the patient is not uncovered. Warmth is applied internally by hot drinks such as coffee or hot beef tea in small amounts, given frequently, and hot enemas, such as two pints of hot saline solution. Care must be taken not to burn the patient. Stimulants used *by mouth* are one-half teaspoonful of aromatic spirit of ammonia in one-half glass of hot water, hot coffee, hot tea, hot beef tea, or plain hot water; *hyperdermically*, one-thirtieth grain of strychnine, or caffeine and sodium benzoate, 2 to 5 grains; and by *inhalation*, smelling salts or ordinary water of ammonia. Unconscious persons or those unable to swallow should never be given anything by mouth. The inhalation method is particularly useful in such cases.

It must be borne in mind in the treatment of all severe injuries that they are accompanied by more or less shock, and that the treatment of this shock is perhaps just as important as the treatment of the injury itself.

HÆMORRHAGE.

Hæmorrhage or *bleeding* is the escape of blood from the heart or blood vessels due to a break in their walls. Hæmorrhage is spoken of as *arterial*, *venous*, and *capillary*, depending upon whether the escape of blood is from arteries, veins, or capillaries. In *arterial hæmorrhage* the blood is bright red in color, and escapes in jets; in *venous hæmorrhage* there is a rapid flow of dark blood, a welling up, as it were, without any spurting; and in *capillary hæmorrhage* there is a steady oozing of red blood from the entire wounded surface.

Nature's method of arresting hæmorrhage is by the clotting of blood thus forming a plug at the point of bleeding. In the average healthy person, it takes from three to five minutes for blood to clot. There are, however, some abnormal people whose blood clotting time is very much lengthened and the arrest of hæmorrhage in them is very difficult. These people are spoken of as *hæmophiliacs* or *bleeders*. The clot of blood which arrests the hæmorrhage eventually organizes and permanently plugs the break in the vessel wall if it

remains undisturbed. Certain factors favor and hasten the formation of a clot at the point of bleeding, such as the stopping or slowing of the blood stream at that point, and the obliteration or decrease in size of the opening in the blood vessel where the hæmorrhage is occurring. When an artery is cut or torn, the muscular wall contracts thus decreasing the size of the opening. With the increase in loss of blood, the pressure within the circulatory system becomes lower and lower. When the hæmorrhage occurs in a confined space, the pressure of exuding blood in the surrounding tissue and on the blood vessel wall tends to slow the current of blood and close the opening in the blood vessel wall.

Treatment.

It is possible to assist nature in arresting hæmorrhage by elevation of the bleeding part, thus decreasing the pressure of blood at the point of hæmorrhage with the help of gravity; by keeping the patient at complete rest so that the blood clot at the point of bleeding will not be disturbed and so that the blood pressure at that point will be as low as possible, due to the slow beating of the heart; by the application of heat or cold, which tends to cause the blood vessel wall to contract; by the use, at the point of hæmorrhage, of styptics, medicinal substances which act to hasten blood clotting or cause contraction of blood vessel walls; by the use of pressure to close the bleeding vessel; and by the use of ligation or torsion, also to close the bleeding vessel. *Do not give stimulants* in treatment of hæmorrhage, as they increase the blood pressure and tend to cause the dislodgement of the clot at the bleeding point.

Capillary hæmorrhage is treated by elevating the part and applying very hot or very cold water, followed by the application of uniform pressure by means of a gauze compress and bandage. In some cases it may be necessary to apply a styptic, such as adrenalin. Epistaxis, or nose bleed, and bleeding from a tooth socket after extraction of the tooth are examples of capillary hæmorrhage.

In *epistaxis*, or nose bleed, keep the patient quiet and in a sitting position; remove collar or any constriction about the neck; apply cold or ice to the back of the neck, and instruct the patient to breathe through his mouth and *not to blow his nose*. The cold application to the back of the neck causes a reflex contraction of the blood vessels of the nose. Styptics, such as a solution of alum or of adrenalin, may be snuffed up the nose. Put a roll of paper under the upper lip, between it and the gum. If bleeding still continues, the nostril must be packed by taking some soft material—cotton, linen, or lint—and gently forcing it well back into the nose. If bleeding continues, the person is probably a hæmophilic and a medical officer should be summoned. In severe bleeding from a tooth socket, pack the cavity tightly with cotton or linen saturated with some styptic, such as adrenalin or alum; then have the jaws closed tightly and apply a Barton or a four-tailed bandage.

Venous hæmorrhage.—Elevate the part (so little velocity is there in the venous current that often this procedure alone will stop the bleeding). If bleeding continues, make pressure directly over the wound with a sterile compress. If venous hæmorrhage is from an extremity, the limb should be bandaged from toes or fingers up to the bleeding point in addition to pressure over the point. A common location for severe venous hæmorrhage is from varicose veins of the legs.

Arterial hæmorrhage.—In the *treatment* of arterial hæmorrhage prompt and decisive measures are required, particularly in the case of hæmorrhage from the large arteries. Hæmorrhage from the femoral artery may result fatally in a few minutes. The main reliance must be on the more strenuous methods,

viz., *pressure*, *ligation*, and *torsion*. *Ligation* is the tying off of an artery with sutures, and *torsion* consists in twisting the end of the vessel with forceps or an artery clamp for five or six rotations; the two methods should be left to a medical officer and should not be undertaken by the first-aid man. This leaves the pressure methods available as the main reliance of the first-aid man.

Pressure to control arterial hæmorrhage always must be applied at some point between the bleeding point and the heart, preferably at a point where the bleeding artery can be compressed against bone. (Fig. 52.) Pressure may be applied by means of the fingers, spoken of as digital pressure, or by means of compresses or by the application of a tourniquet. *Digital pressure* can serve only for a short time, as the fingers soon become tired. This pressure should be made with the thumbs and should be firm enough to arrest the bleeding; it should be made over the clothes, as too much time may be lost in removing them. You will know that you are pressing on the right place by feeling the artery beating beneath the thumbs and by the arrest of the bleeding; if you can not find the artery, make pressure directly over the bleeding point. As pressure with the thumb soon becomes tiresome, have an assistant slip his thumb over yours and take your place while you prepare to apply other pressure methods, either tourniquet or compress. A *tourniquet* is a constricting band and there are various kinds. The principle of all tourniquets is a pad over the artery to bring the pressure on the artery and take it off the veins, a band around the limb and over the pad, and some means of tightening the band. There are a number of special tourniquets, but as they are not usually at hand, a suitable one must be improvised. An excellent one may be improvised with a rubber bandage, a number of turns being made about the limb and the rolled portion of the bandage then placed under the last turn in such a position as to press directly on the artery. The most common improvised tourniquet is the so-called Spanish windlass, in which arrangement any rounded, smooth, hard object, such as a stone, a cork, or a roller bandage, is used as a compress; for the band, a handkerchief, a suspender, a waistbelt, a bandage, or anything of the sort may be used. To tighten the band, a stick or bayonet, scabbard, or something of the kind is passed under the band and twisted until the bleeding ceases, when the ends of the stick are tied to the limb to prevent the band from becoming untwisted. *Pressure by means of compresses* may be effected as follows: A number of small pieces of gauze or linen, or a tampon, previously rendered sterile or antiseptic, are placed in the wound, one on top of the other, until there are a sufficient number to compress the bleeding vessel; a bandage then is applied firmly to hold them in place and exert the necessary pressure. Sometimes more effective pressure can be obtained by employing a compress of gradually increasing size (cone-shaped with apex nearest the vessel). Compresses may be applied in the same manner along the course of the vessel.

The dangers in the use of tourniquets and constricting bands for the control of hæmorrhage are that if applied tight enough to stop artery hæmorrhage they cause pain and swelling of the limb, and if left long enough may cause gangrene or death of the part below the constriction. Therefore they should be watched and loosened from time to time, at about half-hour intervals. If on loosening the tourniquet the bleeding starts again, tighten it up; if there is no appearance of bleeding leave the loose tourniquet in place, with an attendant instructed to tighten it should the bleeding recur. The tourniquet method is the most effective in the majority of cases, but due to the attendant after dangers, in all but the most severe hæmorrhages of the larger arteries arrest of the bleeding by elevation of the part and the compress method should be tried first. All possible care should be taken not to infect the tissue with dirty applica-

tions, but sometimes in tremendous hæmorrhages all these precautions have to be laid aside to save the person's life. In all cases of severe hæmorrhage the above-mentioned measures are only preliminary to arrival of a surgeon.

With great loss of blood, the patient suffers severe collapse and must be given treatment for shock, except that stimulants must not be given unless the blood vessel has been safely secured against recurrence of the hæmorrhage. After severe hæmorrhage tremendous thirst generally is complained of and should be relieved with frequent, small drinks. This may be termed the *constitutional treatment* of hæmorrhage.

The specific treatment for hæmorrhage from certain parts of the body is described immediately following.

Bleeding from the scalp.—Apply pressure over wound with compress and bandage.

Arterial bleeding from the lips.—Grasp lips between thumb and fingers on each side of wound, as the arteries to the lips come from both sides.

Arterial hæmorrhage in other parts of the face.—Apply digital pressure on the facial artery against the lower jaw midway between the ear and chin where its pulsation can be left. (Fig. 52.)

Arterial hæmorrhage from neck.—Apply digital pressure with the thumb on the carotid artery against the vertebræ. (A tourniquet can not be used in this location.) (Fig. 52.)

Arterial hæmorrhage from the armpit.—Place a compress in the armpit and bind the arm tightly to the side. If this fails, compress the subclavian artery behind the clavicle (collar bone) between the thumb and first rib, or compress it with a key, the handle of which has been padded. (Fig. 52.)

Arterial hæmorrhage of arm, forearm, or hand.—Apply digital pressure on the brachial artery on the inner side of the biceps, and then apply a tourniquet a little higher up. In case of arterial hæmorrhage of the forearm, a pad may be placed in the bend of the elbow and the forearm forcibly flexed on the arm. In case the hæmorrhage is from the palm, either of the above two methods may be used, or a large firm compress may be placed in the hand with the fingers very tightly closed over it and bandaged in place. (Fig. 52.)

Arterial hæmorrhage from the thigh, leg, or foot.—Compress the femoral artery against the head of the femur just below the middle of the groin with

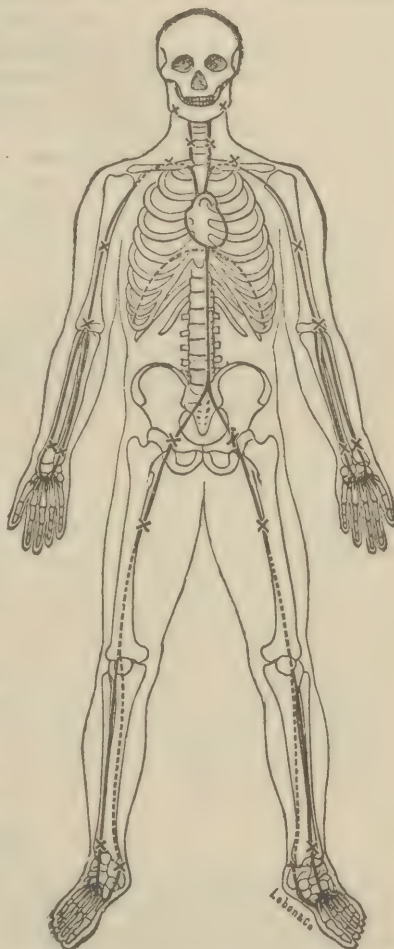


FIG. 52.—Skeleton with black and dotted lines showing the course of the arteries and x indicating the pressure points. (Mason.)

both thumbs, then apply a tourniquet to replace the thumbs. In case the hæmorrhage is in the leg or foot, another method is to put a pad behind the knee, to flex the leg forcibly, and tie it in that position. With arterial hæmorrhage in the foot, in place of the above two methods, compression can be made, when the bleeding point is on the dorsal surface on the anterior tibial artery at the instep; and, when the bleeding is on the plantar surface, on the posterior tibial artery behind the internal malleolus. (Fig. 52.)

Hæmoptysis is hæmorrhage from the lungs. It may result from wounds of the lung but more often is due to disease of these organs. The patient usually is seized by a fit of coughing and spits up bright red, frothy blood. Unfortunately, nothing can be done to arrest the hæmorrhage quickly. The *treatment* consists of immediately summoning a medical officer, and in the meantime keeping the patient absolutely quiet, at rest, and giving ice by mouth. Listen over the chest, and where rattling is heard, apply an ice bag. Avoid all stimulants.

Hæmorrhage from the stomach.—The vomited blood is usually dark in color and may be mixed with food. It always should be remembered that vomited blood does not necessarily indicate hæmorrhage from the stomach; blood coming from the back of the nose and throat may have been swallowed, and inquiry should be made to find out if there has been any nosebleed. The blood from pulmonary hæmorrhage contains air and is frothy while blood from the stomach is not. The treatment is the same as for hæmorrhage from the lungs, except that the ice bag is applied over the upper abdomen.

Internal hæmorrhage, also called concealed hæmorrhage, may occur in any of the cavities and from any of the organs of the body as the result of injuries or disease. It is a condition which may be very difficult to diagnose, as the bleeding can not be seen. Frequently the only symptoms are those of shock. In such cases, summon a medical officer immediately; in the meantime, place the patient flat on his back and keep him absolutely quiet. Opiates are indicated in hæmorrhage of this nature, their purpose being to produce quietness.

Primary hæmorrhage occurs immediately on receipt of a wound or injury. After the arrest of primary hæmorrhage, a recurrence may occur caused by dislodgement of the clot, the slipping of a ligature, or from the opening of a blood vessel by separation of a slough. Recurrence of hæmorrhage within 24 hours is spoken of as *consecutive* or *intermediate*, and recurrence after that time is spoken of as *secondary hæmorrhage*.

WOUNDS.

A *wound* is defined as the forcible solution of continuity of any of the tissues of the body. The principal kinds of wounds are: *Clean* or *aseptic wounds*; *infected* or *septic wounds*; and *poisoned wounds*. A *clean* or *aseptic wound* is one to which no germs have gained access; the best example of it being a wound made by the surgeon's knife. An *infected* or *septic wound* is one in which there have been introduced pus-producing organisms (*see* inflammation), or such organisms as produce tetanus or lockjaw, gas gangrene, or hydrophobia. A *poisoned wound* is one in which some nonliving poison, as distinguished from bacteria or microorganisms, has been introduced by the agent causing the wound; e. g., bites of insects, scorpions, snakes, etc.

An *incised wound* is one made by a sharp cutting instrument, the class of wounds commonly known as cuts. A *lacerated wound* is the result of the tearing of the skin and underlying tissues by blunt instruments or machinery and presents ragged edges, which do not retract much, and which, as a rule, consist of masses of torn tissues, frequently with dirt ground into them. A *contused wound* is one in which the division of tissue is accompanied by more or

less severe crushing. A *punctured wound* is deep and narrow; e. g., stabs are punctured wounds. *Crushing wounds* are more serious than they first appear, due to the fact that the dead tissues are an excellent culture medium for the growth of microorganisms of infective inflammation, resulting sometimes not only in loss of the part but also in general infection of the body; that is, septicæmia or blood poisoning. The term *gunshot wound* is applied to any wound inflicted by a weapon of warfare, such as by rifles, pistols, cannon, etc.

When the skin and underlying tissues are divided, blood vessels, generally capillaries, also are divided, and there is more or less bleeding from the cut surfaces of the tissue, forming a clot between the cut surfaces. Young connective-tissue cells and capillary buds grow into this clot from the edges of the wound, replacing the blood elements. These young connective-tissue cells and the young capillaries form what is known as granulation tissue or "proud flesh." Later the young connective-tissue cells and capillary buds develop into the mature connective tissue, and the epithelium of the skin grows over it from the edges of the wound. When the cut surfaces are so close together that there is very little granulation tissue required to heal the wound, healing is said to be by *first intention*; when the wound is gaping and considerable granulation tissue is required, healing is said to be by *second intention*. Pus infection causes gaping of wounds, therefore in wounds infected with pus bacteria, healing is by second intention. Connective tissue filling in a gaping wound forms the so-called "scar."

Unless cut ends of tendons are brought together, the two ends will be so retracted, and there will be so much connective tissue formed between them in the healing of the wound, that the function of the tendon will be lost. Unless the cut ends of a nerve trunk are brought together, the function of that nerve will be lost forever. Nerve fibrils making up a nerve trunk regenerate centrifugally, and if the pathway for this regeneration is blocked by a wall of connective tissue, these fibrils can never reach the part they are supposed to innervate.

The local factors preventing and delaying the healing of wounds are: Infection with pus bacteria; the presence in the wound of foreign bodies, such as dirt, bits of clothing, etc.; and a lowered vitality of the edges of the wound due to crushing and tearing of the tissues, etc. General and constitutional factors also prevent and delay healing; among these factors being poor circulation of blood, diabetes, Bright's disease, and syphilis.

General principles underlying the treatment of wounds.

Stop hemorrhage and treat shock; so handle the wound as not to introduce fresh bacteria of infection; remove foreign bodies such as dirt, bits of clothing, etc., from the wound; if infective bacteria already have been introduced into the wound, take measures to eliminate them or to prevent their development. If the wound is an aseptic one, bring the edges together so that it can heal by first intention; if the wound is an infected one, keep the wound open and furnishing drainage (*see* inflammation); if the wound is a poisoned one, neutralize the poison in it and prevent its entrance into the general circulation; treat any constitutional condition which may delay or prevent healing.

There are two main types of infective bacteria as applied to wounds: *Aërobic* and *anaërobic*. *Aërobic bacteria* are those that live and multiply in the presence of air; *anaërobic bacteria* are those which live and multiply in the absence of air. The bacteria which cause infective inflammation or blood poisoning are principally *staphylococci*, *streptococci*, and *bacillus pyocyaneus*, these being *aërobic*. There are several *anaërobic bacteria*, viz., those of

tetanus or *lockjaw*, of *hydrophobia*, and of *gas gangrene*, which was such a common infection in the trenches during the World War.

Inasmuch as the bacteria of pus infection are present everywhere, any wound is likely to be infected with them. However, contused and lacerated wounds are most likely to suffer from infective inflammation, owing to the lowered vitality of the tissues. The bacteria of tetanus or lockjaw and of gas gangrene are found in exceptional numbers in the intestinal contents of herbivorous animals, such as horses and cattle, and, for that reason, wounds inflicted by objects which have been contaminated by manure or by heavily fertilized soil are most liable to have introduced into them the bacteria of these diseases. In badly lacerated wounds and in punctured wounds there is great likelihood of absence of air due to the flapping back of the torn tissues after infliction of the wound, and for this reason these types of wounds afford a very favorable environment for the development of tetanus or gas gangrene. The bacteria of hydrophobia are found in the saliva of a rabid animal, and are introduced by their bites. These bites are generally either lacerated or punctured wounds, with their associated anaërobic conditions. Tetanus or lockjaw frequently occurs after stepping on a nail near a barn or stable, the nail previously having become infected with tetanus bacilli from the excretions of the horses or cattle.

A *wound dressing* consists of everything used to cover or dress a wound. The pad which is put directly over the wound is called a *compress*. In ordinary emergency treatment a wound dressing consists of a compress with bandage to hold it on. A dressing may be either dry or wet, aseptic or antiseptic. An *aseptic dressing* is one which is sterile; that is, one with no bacteria on it. An *antiseptic dressing* is one which, in addition to being sterile, contains some substance for killing bacteria. A *wet dressing* generally is an antiseptic dressing. A *wet antiseptic dressing* generally is used in wounds where infective inflammation is going on, whereas a *dry sterile dressing* is used to cover a recent wound which is considered to be free from infection. The purpose of a wound dressing is to stop hæmorrhage, to prevent introduction of bacteria, and to prevent further injury to the wound.

The Navy supplies a first-aid packet which is an hermetically sealed tin can containing a dry sterile dressing. This is excellent for a small wound. The directions for its use are contained in the packet. For large wounds, sick bays aboard ship are furnished with large and small shell-wound dressings. All these dressings consist of a sterile gauze compress with bandage attached. Any piece of cloth such as gauze, cotton, linen, muslin, or a handkerchief is suitable for a compress in case of emergency, *provided it is rendered sterile*, and anything that can be used for bandaging is suitable as a bandage. The most vital point about material used as the compress of a wound dressing is that, before it is applied to a wound, it should be rendered sterile.

The part of the dressing which is to come in contact with the wound must be kept absolutely sterile; i. e., it must not be touched with any part of the body or anything else except sterile instruments allowed to touch it before its application to the wound. In an emergency, material to be used in a wound dressing may be sterilized by boiling it for 10 minutes.

When a patient can be brought under the care of a medical officer in the very near future, the procedure necessary in the first-aid treatment in the case of ordinary wounds is: Stop the hæmorrhage, treat the shock, and apply a sterile dressing to the wound. If a surgeon is not available, the wound must be further treated as described hereafter.

In treating a freshly made wound suspected of being contaminated (all wounds should be suspected of contamination by infective organisms unless

made under strictly aseptic precautions) the following procedure is recommended: Cleanse one's own hands as thoroughly as possible by a thorough scrubbing with soap and hot water, followed, if possible, by immersion of the hands in hot 1:1,000 bichloride of mercury solution or in 70 per cent alcohol. Sterilize all instruments to be used in removing foreign bodies such as dirt, glass, splinters, etc., or for shaving the skin about the wound. If there is much bleeding, arrest the hæmorrhage. If there is much hair about the part, remove it by cutting or shaving for a distance of several inches from the cut edges. If there is much grease in and about the wound, remove it with turpentine or gasoline. Remove all foreign particles with sterile forceps. Clean the skin about the wound with a sterile damp cloth, and, while doing this, protect the wound with a piece of sterile gauze. Dry the wound and skin about it with sterile dry cloth or cotton. Apply tincture of iodine to all parts of the wound and to the skin about the wound for a distance of about one-half inch beyond the wound edges. After the skin has been well dried, the wound edges are brought together and dry wound dressing applied.

There is no substance which should be used by the first-aid man to wash a wound. In the first place, he only washes in more dirt than he washes out, and, secondly, ordinary water is dangerous, as it contains many bacteria; this applies equally to soap and water. Strong antiseptics such as bichloride of mercury or carbolic acid will destroy the cells of the body which dispose of the pus bacteria, before they kill the latter, and should never be used except in certain wounds described below. Peroxide of hydrogen is not strong enough to kill all bacteria, and in a large or deep wound it washes some of these bacteria to uninfected parts which then become infected. Therefore, use none of these preparations in a wound, which should be covered with a sterile cloth, while cleaning the skin around the wound as described above. If, however, there is much greasy dirt rubbed into the wound, the latter should be gently swabbed out with sterile gauze or a cotton applicator, saturated with benzine or gasoline, and foreign bodies picked out with sterile forceps. *Tincture of iodine is the only substance to be used in an ordinary fresh wound by the first-aid man, aside from benzine and gasoline to cut grease, if present.* The tincture of iodine should be used within two hours after the wound is inflicted, as after that time it is probably valueless. Tincture of iodine is best applied with a camel's-hair brush, but a bit of cotton on a stick answers the purpose very well; the brush or cotton need not be sterilized, as the iodine accomplishes this. The tincture of iodine may be poured into a wound. Iodine can be used in wounds practically anywhere in the body except in or near the eyes, *where it must never be used.*

Attempts to bring the wound edges together should not be made when the patient can be brought under the care of a surgeon in the very near future, but if a question of days is to elapse before the service of a medical officer can be obtained, coaptation should be done in cases requiring it. The edges of a wound should not be brought together before foreign bodies and dirt have been removed and wound edges cleaned. Wounds in which infective inflammation is going on should be left open and allowed to drain. The two methods by which coaptation may be accomplished are by means of *sutures* and by means of *adhesive strips*. The former is preferable, as by the latter method bacteria of infective inflammation most probably will be introduced. As a rule, the edges of large deep wounds should not be too tightly apposed. Some chance of escape should be left for the serum and blood which are sure to be present; that is, means of drainage should be applied. This may be done by the use of small pieces of sterile rubber tubing, strands of catgut or silkworm gut, or a

narrow strip of gauze which has been sterilized by boiling. These drains should be placed in the lower angle of the wound. Wounds which are dirty and look badly should be left wide open. (Figs. 100, 101.)

The materials ordinarily used for sutures are *plain catgut*, *chromicized catgut*, *kangaroo tendon*, *silkworm gut*, *silk*, or *linen*; sometimes *horsehair* also is used. *Suture material*, also called *ligatures*, is divided into absorbable and nonabsorbable ligatures. *Absorbable ligatures* are those which can be left in a wound, inasmuch as the tissues absorb them, and included in this class are catgut and kangaroo tendon. Silkworm gut, silk, linen, and horsehair are *nonabsorbable ligatures* and must be removed after six or seven days. *Chromicized catgut* is catgut which has been so treated that it is not as quickly absorbed as plain catgut. Catgut is the ligature to be preferred in the suturing of wounds. *Needles* used in the suturing of wounds are: *Curved*, *straight*, and *round*, or *cutting*. Where the skin must be pierced, the curved cutting needle is preferable. The main point about all suture material to be used in a wound is that it must be sterile. In case of emergency, an ordinary seamstress' needle with cotton or silk thread, well sterilized by boiling, may be used. This suture is nonabsorbable and must be removed after six or seven days. With the operator's hands, and also the wound, well cleansed, the needle, threaded with the suture, is passed through the skin about one-eighth of an inch from the cut edge and on out through the opposite side at a corresponding point. The suture then is tied, and the ends cut, leaving about one-quarter of an inch remaining; care should be taken in tying the suture to use but little tension, sufficient only to bring the cut edges in accurate approximation. The remaining stitches are inserted in the same manner at a distance of from one-quarter to one-half of an inch apart until the wound is closed. When a tendon or large nerve has been cut, the ends must be brought together and sutured with catgut before the wound is closed. Suturing of tendons and nerves should be done by medical officers.

The manner in which a wound showing evidence of infective inflammation is treated, is: Elevate the part; put it at rest; remove foreign bodies, if present; remove enough sutures, if present, to obtain good drainage; insert drain; apply a wet antiseptic dressing; and treat the constitutional symptoms.

Wet antiseptic dressings generally are made up of a layer of sterile gauze, saturated with an antiseptic solution, to be applied directly on the wound. A layer of sterile cotton is then applied, some impervious material such as oiled silk or waxed paper put over the dressing in order to retain the moisture, and a bandage over all. The dressing should be kept wet with the antiseptic solution, either by frequent changing or by having perforated rubber tubes between the gauze and cotton through which the dressing can be periodically moistened with the antiseptic solution. The antiseptic solutions usually employed in wet dressings are: Bichloride of mercury solution 1-5,000; saturated solution of boric acid; and Dakin's solution. *Bichloride of mercury solution* should not be applied on a wound freshly painted with tincture of iodine, as a very corrosive iodide of mercury is formed.

If the symptoms of an infected wound are severe, put the patient to bed, clear out the bowels with a brisk purgative, and apply an ice cap to the head to reduce the fever.

The measures taken in fresh wounds suspected of being infected with tetanus or gas gangrene are: The wound is cleaned and treated as above, and kept freely open for a time in order that anaërobic conditions may not exist for the growth of these bacteria. As a further precautionary measure, tetanus

antitoxin is given. A punctured wound suspected of being infected is frequently cauterized with pure carbolic acid, afterwards applying alcohol and a dry wound dressing.

Symptoms and treatment of special types of wounds.

Wounds inflicted by an animal suspected of being rabid or of having rabies are to be treated in the following manner: Thoroughly cauterize the wound with fuming nitric acid and neutralize with sodium hydrate solution, 1 per cent, or sodium bicarbonate solution, 10 per cent. The Pasteur treatment may

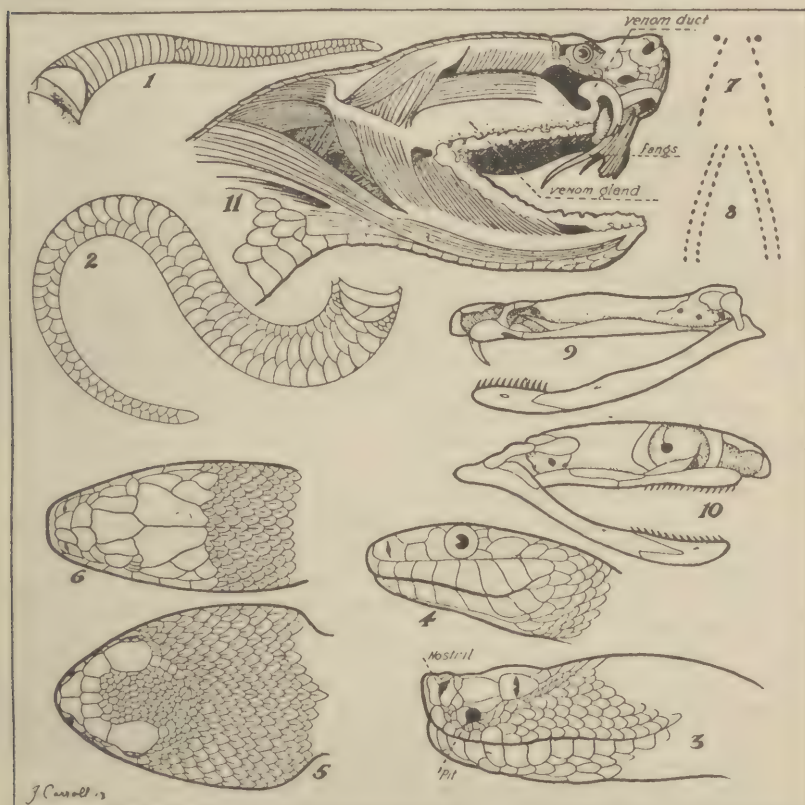


FIG. 53.—1, Single row of scales posterior to vent (poisonous snake—water moccasin); 2, double row of scales of harmless snake (*Natrix*); 3, side view head of pit viper; 4, side view head of harmless snake; 5, dorsal view pit viper; 6, dorsal view of harmless snake; 7 and 9, bite puncture and skull of *Elaps*; 8 and 10, same of harmless snake; 11, poison apparatus of rattlesnake. (Stitt.)

be given later. In the absence of fuming nitric acid, a red-hot needle may be used to cauterize the wound. Do not use silver nitrate or carbolic acid for cauterizing these wounds. Apply a dry wound dressing.

Poisonous wounds due to causes other than to bites of poisonous snakes include ordinary insect bites, such as those produced by mosquitoes, fleas, ants, and bees. These bites require but little treatment. Sometimes the sting of a bee is broken off and remains in the skin. In treating these cases always search for the sting and remove it if it be present. As the poison of insects is composed chiefly of an acid, the local application of some alkali should be em-

ployed, either water of ammonia or a solution of washing soda affords great relief. *Bites of the more poisonous spiders, centipedes, tarantulas, and scorpions* require prompt treatment. Tie a ligature or tourniquet about the injured part between the wound and the heart to prevent absorption into the general circulation; enlarge the bite by making an incision at its site, suck out the wound to produce bleeding, and apply crystals of potassium permanganate or tincture of iodine. If there be abrasions or open lesions in the mouth, it is not advisable to suck the wound. Release the tourniquet after a time to permit temporary restoration of circulation, replace it and repeat this process every half hour as long as may be necessary. Apply a wound dressing to the wound and treat shock which sometimes occurs in these cases.

Poisonous snakes are classified into *viperine snakes* and *colubrine snakes*. To the viperine family belong the *rattlesnake*, the *copperhead*, the *water moccasin*, the *viper*; to the colubrines belong the *cobra* and the *coral snake*. In poisonous snakes the teeth are arranged in two rows, with a fang on each side, outside the teeth near the point of the jaw. Nonpoisonous snakes have four rows of teeth without fangs. (Fig. 53.) The imprint of the wound often will tell whether a person has been bitten by a poisonous or a nonpoisonous snake. The venom of different poisonous snakes differs in its action. The poisonous constituents are *neurotoxin*, a nerve poison, and *hemorrhagin*, which injures the lining of the blood vessels so that an escape of blood occurs into the surrounding tissues; a third constituent is *hemolysin*, which destroys red blood cells. The venom of colubrine snakes is made up principally of neurotoxin and that of viperine of hemorrhagin. In *colubrine poisoning*, the local symptoms are not marked, though there are at times severe pain and some tenderness, swelling, and discoloration at the site of the bite; then in 1½ to 2½ hours the patient begins to feel tired and drowsy, there often being some nausea and vomiting; paralysis sets in, generally affecting the extremities first and then becoming more generalized, finally affecting respiration, so that the patient's breathing becomes slow and shallow and finally ceases; convulsions also may be present. In *viperine poisoning* there is pain at the seat of the bite, which soon becomes excruciating, with rapid swelling and discoloration; there is at the same time a feeling of nausea and faintness, while a sense of depression takes hold of the individual; the pulse becomes rapid and feeble, and the breathing is labored; in fatal cases, death may occur in 24 to 48 hours. The severity of the symptoms and final outcome depend upon the amount of venom injected and absorbed into the general circulation, which in a large measure depends on the size of the snake.

The *treatment* of wounds inflicted by a poisonous snake follows: If the wound is in an extremity, tie a bandage or handkerchief tightly about the limb between the wound and the heart; incise the wound freely and suck out as much of the poison as possible. If there be abrasions or open lesions in the mouth it is not advisable to suck the wound. With a hypodermic syringe, inject a 2-per cent solution of potassium permanganate into and about the bite to destroy any poison which is left. If a hypodermic syringe and potassium permanganate is not available, the bite should be cauterized with a lighted match, a hot coal, or a little gunpowder rubbed in and ignited. Meanwhile, give stimulants in the shape of coffee and strychnine, one-thirtieth grain. The ligature should be loosened about every half hour to allow restoration of the circulation, but should be tightened up immediately if symptoms of general poisoning occur. There are two serums on the market for the treatment of poisoning by snake bite; one which neutralizes neurotoxin and another which neutralizes hemorrhagin. They are injected hypodermically or intravenously and are very

effective if properly used; that is, serum to combat the venom of a colubrine snake must be used against that type of snake bite, and the specific serum for the viperine snake venom used to combat the toxin of that type of snake, in order to get results.

Gunshot wounds inflicted by bullets.—Always look for the wounds of entrance and of exit and apply a sterile dressing to each. Concealed hæmorrhage and injury to internal organs are the most dangerous results of these wounds and depend on the course taken by the bullet. The wounds of entrance and exit caused by high velocity bullets may be so small as to be hardly visible, while the wound of entrance may be very small and the wound of exit large, due to the explosive effect of the high velocity bullet on the tissues. *Never probe a bullet wound*, as a bullet is very likely to be sterile, and by probing you are almost sure to introduce germs of infective inflammation.

Symptoms and treatment of penetrating wounds of the chest.—The symptoms are the presence of air bubbles in the wound, difficult breathing, coughing, and spitting of blood. The first-aid treatment consists in laying the patient on the injured side, firmly bandaging the chest, summoning medical aid, and the general treatment for wounds.

Symptoms and treatment of wounds of the abdomen with injury to the intestines and stomach.—The signs of injury to the intestines are the escape of gas or feces through the wound and the passage of blood in the stools. Injury of the stomach may result in the escape of its contents through the wound and the presence of bloody vomitus. Keep the patient absolutely quiet and place under the care of a surgeon as soon as possible, as every moment's delay in surgical treatment lowers his chance of recovery. With a large abdominal wound from which more or less of the abdominal contents escape, place a sterile cloth over the wound and the extruded intestines; bandage in place and keep the dressing wet with sterile normal salt solution until the patient can be placed under the care of a surgeon.

Treatment for wounds of the eye.—Remove the foreign body, if present, as described under removal of foreign bodies (p. 87). Never use tincture of iodine or other strong antiseptics in the eye. Boric acid solution or an organic silver preparation (silvol or argyrol) are the only antiseptics to be used in the eye. All eye wounds should be brought under the care of a medical officer as soon as possible. In the meantime cover both eyes with absorbent cotton or soft cloths so as to keep the eyelids still, and hold the dressing in place with bandages around the head. Be careful not to put on these bandages so tightly that they will cause pressure on the eyeball. In case some time must elapse before the services of a medical officer can be obtained, the dressing should be kept wet with cool saturated solution of boric acid, and if secretions are present, the eye should be irrigated at frequent intervals with warm saturated solution of boric acid. In lifting the eyelid do not press on the lid, but lift the upper lid by traction on the region above it; this prevents scratching of the cornea by pressure.

CONTUSIONS, STRAINS, AND SPRAINS.

A *contusion*, or as it is commonly termed, a *bruise*, is a crushing and tearing of the tissues, usually without a break in the skin. It is characterized by swelling, tenderness, and discoloration, due to the rupture of blood vessels in the neighborhood of the injury. At first the discoloration is red, then blue or black, and finally turns yellow or green, commonly called black and blue spots. The change in color is due to the chemical change in the coloring matter of the blood hæmoglobin. The rapidity in the formation of the

swelling and its size depends on the number and size of the blood vessels ruptured. Contusions vary in extent from an ordinary black and blue spot to the almost complete pulpification of a limb with laceration of blood vessels and nerves such as sometimes occurs in railway or other accidents. A "black eye" is an example of a contusion.

Slight contusions as a rule require no treatment. With severe contusions there is more or less shock which must be treated. For the contusion itself, the *treatment* is to stop the subcutaneous hæmorrhage; this can be done by rest and elevation of the part; by very hot or cold applications; and if the injury is in a limb, firm, even pressure of a bandage may be effective. Later, when the bleeding has ceased, the absorption of the extravasated blood may be hastened by hot fomentations and massage. In the case of severe contusions and in contusions in elderly people, hot water is much better than cold, as the latter tends to lower the vitality of injured tissue.

A *strain* is the overstretching of a muscle or tendon with an attendant rupture of the muscle or tendon fibers. In severe strains, small blood vessels

often are ruptured, resulting in the escape of blood into the muscles in the same way that, in the case of a bruise, blood escapes beneath the skin. It is generally the result of violent exertion or sudden unexpected movement. The symptoms are pain in the affected muscle, stiffness, lameness, and more or less swelling. If complete rupture occurs, there will be loss of power of the affected muscle and on examination there will be found a distinct gap with considerable swelling above it, due to retraction of the muscle fibers.

For slight strain, the *treatment* consists of strapping with adhesive plaster or bandages, which, with rest, gives the most comfort. After two or three days, graduated massage may be given. If rupture occurs, in the absence of surgical assistance immobilize the part by splints or bandages and place the part in such a position that the muscles are relaxed, thus allowing the torn fibers to come together.



FIG. 54.—Strapping of ankle. First step. (Owen.)

A *sprain* is an injury to a joint due to wrenching or twisting its ligaments and adjacent soft parts. There also may be injury to cartilages, and even portions of bone to which the ligaments are attached may be torn away. Accompanying these injuries there is more or less escape of blood into the joint itself and surrounding tissues, resulting in severe pain and marked swelling of the injured part. Later, discoloration develops at the site of injury. Sprains of the ankle and wrist are the most common. Frequently it is difficult to determine whether or not a sprain is not complicated with fracture. An X-ray examination is always advisable to determine the presence of a fracture in these cases.

In the *treatment* of sprains all severe cases should be brought under the care of a medical officer, particularly as the condition may be complicated with fracture. Elevate the joint and apply very hot or very cold water for one-half an hour to an hour to stop the subcutaneous hæmorrhage; then apply a tight bandage and keep the joint at rest in order to give the torn ligaments and tissues a chance to heal and the effused blood to be absorbed. Treatment of a sprain of the ankle by immediate strapping of the joint and allowing the patient to walk about may be practiced in the less severe uncomplicated cases.

For this purpose strips of adhesive plaster 1 to 1½ inches wide and about 18 inches long should be obtained. A strip is started well behind at the junction of the lower and middle third of the leg on the uninjured side, and is carried down under the heel with considerable tension, across the sole, and up the other side of the joint. (Fig. 54.) The middle of another strip is applied to the point of the heel and the two ends are carried forward over the foot, but not far enough to meet. Leg strips and foot strips alternate, interlacing with each other and overlapping about one-third of the previous strip each time until the ankle joint is covered. Strapping in this manner furnishes pressure and at the same time fixes the joint and gives support to the torn ligaments. (Fig. 55.) If an individual is unable to walk immediately after injury to the ankle, the injury should be considered as a fracture until proved otherwise.

DISLOCATIONS.

A *dislocation* is a slipping away from each other of the bones which form a joint, resulting usually in a locking of the bones in the new position. Necessarily the dislocation is attended with tearing of the ligaments, and often with rupture of the muscular attachments as well, except in a joint which, on account of frequent prior dislocations, has had its ligaments so stretched that not only is dislocation easy but no tearing of the ligaments results. As a result of the tearing of structure about the joint, there is also rupturing of the blood vessels, with consequent swelling and discoloration.

Dislocations must be differentiated from fractures and sprains. In all three conditions there may be swelling and pain in the neighborhood of a joint. In fracture there is an unnatural movement of the bone between the joints instead of immobility at the joint as in dislocations, and the movement is attended with a grating sound and sensation; the deformity is in the bone between the joints in fractures, whereas the deformity is at the joint in dislocations. In dislocations there is immobility at the joint and between the joints, and the head of the dislocated bone may be felt in an abnormal position. In sprains there is absence of any of the symptoms of dislocation except swelling and pain. As a rule sprains are momentary dislocations in which the head of the bone has slipped back into place.



FIG. 56. — Clove hitch. (Da Costa.)



FIG. 55. — Strapping of ankle. Completed. (Owen.)

The *treatment* consists in restoring the bones to their normal positions, spoken of as “reducing the dislocation,” and then so confining the parts that a recurrence of the trouble will be improbable. The joint should be immobilized until the rents in the ligaments have healed. While some dislocations slip easily back into place, to properly reduce the majority requires considerable knowledge and skill. Without careful manipulation blood vessels and nerves not only may be injured but a simple dislocation may become complicated with fracture. In view of the above, if surgical aid can be obtained within a day or two, do not attempt to reduce a dislocation, except perhaps in case of the jaw

and finger; loosen the clothing about the injured part and support it as comfortably as possible in the new position, or if the patient must be moved, support the limb in a sling or by splints and bandages, and summon surgical assistance. If, however, surgical assistance can not be had for some time,



FIG. 57.—Dislocation of jaw.

three or four days, careful attempts should be made to reduce the dislocation, as the head of the bones concerned most probably will become bound by connective tissue formation and then reduction will become next to impossible without an operation. Shock is often present with major dislocations and should be treated.

Treatment of certain dislocations.

Dislocation of the jaw.—In this condition the patient can not speak or close his jaws. The dislocation is due generally to a blow upon the mouth when open or by yawning or laughing. This dislocation usually is reduced without

much difficulty, but there is great danger of the thumbs of the operator being bitten. Wrap the thumbs well with a handkerchief or bandage, stand in front of the patient, and while pressing with the thumbs in the mouth just back of the last lower molars, at the same time lift up the chin with the fingers. The jaw usually will snap at once into place, and the thumbs must be quickly withdrawn to prevent them from being bitten. After reduction, bind the lower jaw to the upper with a Barton or a four tailed bandage. (Fig. 84.)

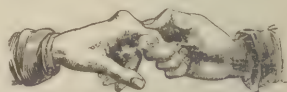


FIG. 58.—Backward dislocation of finger. Reduction by extension. (Hamilton.)

Dislocation of finger joints.—With a dislocated finger joint, pull on the dislocated end, at the same time bending it backward if the dislocation is forward, or forward if the dislocation is backward, and pushing the joint into place; strap or splint the finger. (Fig. 58.)



FIG. 59.—Subglenoid dislocation of the shoulder. (Mason.)

Dislocation of the shoulder.—In this dislocation, the arm is held rigid, the elbow stands off a distance of 3 or 4 inches from the body, and the shoulder appears flat with a marked depression beneath the point of the shoulder. In addition there is a pain and swelling at the site of injury; and the head of the humerus can be felt in an abnormal position as compared with the other side. Do not try to reduce this dislocation if surgical assistance can be had in a few days; if not, try one of the three methods below. (Fig. 59.)

(a) *Stimson's method.*—Place the patient on a canvas cot or stretcher, lying on the injured side, arm hanging through a hole made in the cot or stretcher in the median line at a distance of about 18 inches from the head end. The cot or stretcher first should be elevated from the floor by means of chairs or blocks so that the hand does not touch the floor. Fasten a 10-pound weight on the dependent arm, and, in from 5 to 10 minutes, the muscles usually have become sufficiently relaxed to

allow the head of the bone to slip into its proper place of its own accord. If it should not do so, the weights should be removed and the arm carefully brought to the patient's side against the operator's fist, held in the armpit. This should force the head of the bone back in place. Apply a Velpeau or Desault bandage without the pad in the armpit and keep the arm bandaged for a week.

(b) *Kocher's method.*—The patient should be in either the sitting or standing posture, preferably the former. Grasping the affected arm at the elbow



FIG. 60.—Kocher's method of reduction by manipulation: *a*, First movement, outward rotation; *b*, second movement, elevation of the elbow; *c*, third movement, inward rotation and lowering of the elbow. (Ceppl.)

and wrist, flex the elbow to a right angle and press the arm against the chest. (Fig. 60.) Turn the forearm as far as possible from the chest by external (outward) rotation of the humerus. Maintaining this external rotation, carry the elbow slowly inward across the front of the chest to the center line of the body. With the arm in this position quickly rotate the forearm inward until the hand touches the sound shoulder. Lower the elbow. Immobilize the entire arm by the application of a special bandage of the chest or a Velpeau bandage without the axillary pad.

(c) *Reduction by traction or extension.*—

Place the patient upon his back on the deck or table. The operator takes off one shoe, inserts his heel under the armpit of the dislocated side and makes traction upon the arm downward and slightly toward the patient's body. In doing this, care must be taken not to employ too great leverage action upon the arms, as a fracture might be produced. After reduction, immobilize the joint with a Velpeau or Desault bandage without the pad in the armpit, and keep the arm bandaged for a week. If dislocation fails to be reduced by above methods, do not persist in your efforts, as it is then a case for operative surgery. (Fig. 61.)



FIG. 61.—Reduction of dislocation of humerus by heel in axilla. (Erichsen.)

Dislocation of the elbow, hip, and knee.—These dislocations are not as common as shoulder dislocations. The bones may be displaced in various directions and their reduction is difficult and often dangerous. First-aid treatment consists in obtaining surgical assistance, making the patient comfortable with pillows, etc., and treating for shock, if present.

Compound dislocations are those in which the head of the bone has been forced through the skin and underlying tissues. Here not only the dislocation

but also the wound must be treated. A *complicated dislocation* is one in which a large blood vessel or nerve has been injured.

FRACTURES.

A *fracture* is a break in one or more bones of the body. Fractures are classified as *simple* or *closed*, and *open* or *compound*. A *simple* or *closed frac-*

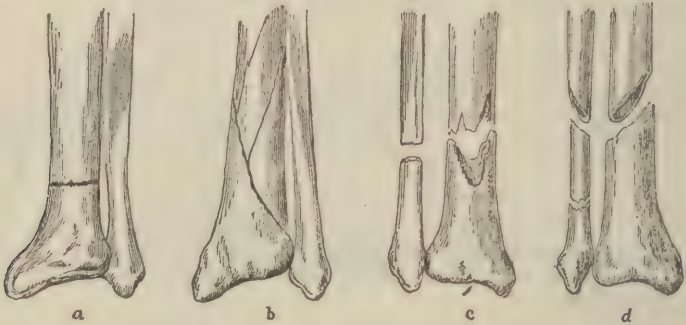


FIG. 62.—Complete fractures: *a*, Transverse; *b*, spiral; *c*, dentated; *d*, oblique or multiple. (DaCosta.)

ture is one in which there is no opening to the outside air. An *open* or *compound fracture* is one in which, by a break in the overlying skin and other tissue, there is direct communication between the outside air and the broken bone. A compound fracture is always very serious, owing to the likelihood of infection. In an infected compound fracture, not only is it difficult to obtain union of the bones, but there is danger to life from the infection itself. This element of infection is absent in simple fractures.



FIG. 63.—Green-stick fracture.

Careless handling of fractures may convert a simple into a compound fracture, and there is grave danger of injuring blood vessels, nerves, and other tissues in the neighborhood of the fracture (complicated fracture).

A *complete fracture* is one in which the bone is severed through its entire thickness. (Fig. 62.) An *incomplete* or *green-stick fracture* is one in which the bone is broken or bent, but not broken entirely through. (It resembles the condition obtained from an effort to break a green stick.) (Fig. 63.) A *multiple fracture* is one in which the bone is broken into more than two fragments, the lines of fracture, not, however, communicating with each other. A *comminuted fracture* is one in which the bone is broken into several pieces, the lines of fracture communicating with one another. (Fig. 64.) A *complicated fracture* is one accompanied by an injury to some surrounding part, as an injury to a joint, muscle, nerve, or blood vessel. An *impacted fracture* is one in which one fragment of the bone is driven into the other, the two remaining tightly wedged. (Fig. 65.)

When a bone breaks, there is always an injury to the periosteum, or bone covering, and to the surrounding tissues. There is also hæmorrhage about the ends of the fragments, and the space between the two fragments rapidly be-

comes filled with a blood clot. This blood clot becomes organized as described in the healing of wounds, forming a callus which surrounds the ends of the fragments, and, as it were, glues them together. At first the callus consists only of fibrous tissue, but later there is growth of bone cells, and a deposit of lime salts which changes the callus into dense bone.

The following factors may prevent the union of fractures: Infection preventing the formation of a callus; the interposition between the fragments of muscle of other tissue; improper reduction of the fracture; general constitutional conditions such as syphilis, tuberculosis, diabetes, Bright's disease, and an inability on the part of the patient's body to deposit bone in the callus. This latter condition in which fibrous tissue, but not bone, is deposited in the callus is spoken of as "fibrous union."

In the diagnosis of fracture the following conditions usually will be found: (1) There is a loss of power in the part, for example, if the leg is broken, the man has fallen and can not arise; (2) the part is in an unnatural position, and comparison of a fractured limb with the uninjured one will show that there is a deformity between the joints and that the injured limb is probably shorter; (3) movement can be obtained where normally there is no motion, with grating of the broken ends of the bone; in a fractured limb, if an attempt to move the limb is made it will be found that there is movement in the bone between the joints where there should be none, and the broken ends of the bone grating together (crepitus) can be felt and heard; (4) there is the history of violence and the patient will say that he heard the bone crack and give way; and (5) the patient complains of great pain and tenderness at the seat of fracture and there is swelling present, due to bleeding from the broken ends. Whenever a fracture is suspected or doubtful, an X-ray picture of the part should be obtained, as this is the surest means of determining fracture.



FIG. 65.—Impacted fracture of femur. (Wharton.)



FIG. 64.—Comminuted fracture.

General principles for the treatment of simple fractures.

Take measures to bring the patient under the care of a medical officer. The object of treatment before a medical officer can take charge of the case, if his services can not be had promptly, is to prevent further injury, especially injury to blood vessels and nerves, and puncture of the skin by the sharp, knife-like edges of the broken bone, and to treat shock if it is present. The patient should be placed in a com-

fortable position while waiting for the surgeon, and if it is necessary to move the fractured part in doing this or in treating shock, one hand should support the broken bone on each side of the break. The bone must not bend at the break while the patient changes his position to a more comfortable one. Support the broken bone in a natural position on a pillow or folded coat, great care being taken that it is not bent or does not drag on the point of fracture. If there is doubt as to whether or not a fracture is present, do not manipulate the part, but treat it as a fracture until the arrival of a surgeon. Do not move the

patient more than is necessary before the fracture has been set and secured. If the injured person is wearing thin summer clothing, it will not always be necessary to remove it; if thick clothing is worn, however, it is difficult to determine whether or not a fracture has occurred or the character of the injury. In the latter case, never try to take off the clothing, but cut it in the seams with a sharp knife or scissors. If the patient can not be brought under the care of a surgeon for a day or more, the fracture must be set and immobilized as described below. If a fracture is not set, it will unite in bad position and the bone will have to be refractured to secure proper alignment.

In the treatment of compound fractures the services of a medical officer should be obtained as soon as possible. In the meantime, treat the shock and the wound as described in the section on wounds. After treatment of the wound, treat the fracture as above. In case no surgeon is available for a day or more, the fracture may be set as described below, always keeping in mind the proper treatment of the wound while so doing, thus preventing, as far as possible, infection which is a serious complication in fractures.

The setting of a fracture consists of bringing the two fragments in apposition and in holding them in that position. The force which keeps the fragments out of apposition and which must be overcome in order to bring them into apposition is muscular contraction. This muscular contraction is overcome by extension and counterextension. *Extension* is pulling the far or distal end of the limb, and *counterextension* is merely holding the near or proximal end next the trunk. Extension and counterextension must be applied until the deformity and shortening disappear and the two limbs look alike. Where the muscular contraction is great, as in fractures of the thigh, the fragments frequently can not be brought into apposition without relaxation of the muscles by a general anæsthetic or by gradual tiring out of the muscles by a steady pull with weights and pulley. In these cases extension and counterextension frequently have to be applied for some time after the fracture has been set in order to maintain the fragments in apposition. The fragments of a fractured bone are held in apposition by means of splints, plaster of Paris bandages, ordinary bandages, etc.

Splints are agents for immobilizing a fractured part. There are two general classifications of splints, *traction splints* and *coaptation splints*. *Traction splints* are those which, in addition to immobilizing a fracture, are constructed in such a manner that by their use extension and counterextension can be applied without the use of other apparatus for this purpose. *Coaptation splints* are those which are used solely to immobilize the fracture. Traction splints are indicated in fractures where there is much muscle pull tending to displace the fragments. The most common traction splints are: The *Thomas leg splint* and modifications of the same, the *Jones humerus traction splint*, the *Hodgen anterior thigh and leg splint*, the *wire ladder splint*, and the *Cabot posterior wire splint*. To obtain extension by use of these splints, adhesive strips or tapes are fastened to the skin and attached to the distal end of the splint, while counterextension is obtained by the push of the other end of the splint against the body.

In an emergency any material which has sufficient firmness to give support to a limb will answer for coaptation splints. Examples are umbrellas, canes, swords, scabbards, guns, cigar boxes, wire, leather, laths, tent pins, pillows, or folded coat. In fractures of the thigh and leg, the sound limb may be used as a splint. Plaster of Paris bandage may be used. Adhesive plaster generally is used to splint a fractured rib. The materials used for splints must be light but sufficiently rigid to prevent bending; long enough to fix into the joints above and below the fracture; broad enough to prevent pinching of the

limb in bandaging: and sufficiently padded to protect the part from undue pressure.

Coaptation splints may be applied temporarily over the clothing and should always be well padded, as a hard board against an injured limb soon becomes very painful. Oakum, cotton, grass, moss, portions of clothing, or any soft material will answer for the padding. If possible, two splints should be applied to a limb, while in fractures of the leg three generally are used, one on each side and one behind. In applying splints, have an assistant hold them in position and then firmly fasten them to the limb by several turns of a roller bandage, adhesive strips, handkerchiefs, pieces of rope, or portions of clothing. Whereas splints should be applied snugly, care should be taken not to apply them too tightly for fear of cutting off the blood circulation; leave the tips of the fingers and toes exposed and watch the circulation. If the tips of the fingers are blue and cold, or if, upon pressing upon the nails, the normal pink color does not quickly return, the dressing is too tight. Remember that whereas a splint may be applied with the proper degree of snugness, later swelling of the fractured limb may cause it to be too tight. The use of plaster of Paris as splinting material should be left to the surgeon.

Fractures of the skull are classified as *fractures of the vault* and *fractures of the base* of the skull. Fractures of the skull are dangerous on account of the probability of injury to the brain. In fractures of the vault, the danger lies in tearing of the brain tissue itself by the fragments of bone, and in tearing of the blood-vessel walls, resulting in hæmorrhage, with the resulting compression of the brain. Compression of the brain also may result from the displaced fragments of broken bone. In fractures of the base of the skull, the principle dangers are rupture of the meningeal arteries, resulting in intracranial hæmorrhage and compression of the brain. Both types of fracture may be compound, while there is the added danger of infection which, in fractures of the vault, occurs through injury to the overlying tissue at the site of fracture and, in fractures of the base, to infection from the nose and ears due to a tearing of the mucous membrane of the nose and middle ear.

In *fractures of the skull*, unless compound or depressed, all the usual symptoms of fracture are absent, or entirely overshadowed by the injury to the brain. The most prominent brain symptoms are loss of consciousness and paralysis; if the loss of consciousness is sudden, it is probably due to concussion or to the pressure of a piece of bone; if it comes on slowly, it is apt to be the result of hæmorrhage from a torn blood vessel. In fracture of the base of the skull, there may be bleeding from the nose or ears, or into the orbits, or under the conjunctiva; the escape of cerebrospinal fluid—a clear, watery serum—from the ears is considered a sure sign of fracture of the base.

In the *treatment* of a fracture of the skull obtain the services of a medical officer as soon as possible. In the meantime, keep the patient quiet, in a recumbent position, and apply an ice bag to the head; if the fracture is compound, treat the wound. *Avoid stimulants.*

In *fractures of the spine* the spinal cord is generally injured or cut across, with resulting paralysis to all parts below the fracture. On passing the fingers down the spine, irregularity of the spinous processes with deformity will usually be noted, as well as local pain over site of fracture. Keep the patient perfectly quiet, and lying flat on his back until surgical aid can be obtained. If it is necessary to move him, it should be done with extreme care to prevent any additional injury to the spinal cord.

Symptoms and treatment for a fractured nose.—There is usually considerable deformity, the bridge of the nose being depressed and pushed to one side, crepitus generally can be felt, and there is considerable nosebleed. Return the bones to their normal position, if possible, by gentle manipulation. To hold the bones in position, apply two very small rolls of narrow bandage on either side of the nose and hold the rolls in place with short strips of adhesive plaster. Check the bleeding by syringing the nostril with hot or cold water, or, if necessary, pack the nostrils with cotton. Warn the patient not to blow his nose.

Symptoms and treatment of fracture of the lower jaw.—In fracture of the lower jaw, the line of teeth is irregular and there may be bleeding from the mouth; the patient can not open his mouth, and by passing the fingers along the line of the lower jaw, localized pain and deformity can be noted. Push the bones into place and apply a four-tailed or Barton bandage. The patient must be fed through a tube, and the mouth kept clean, as these fractures are generally compound. Place the patient under the care of a surgeon as soon as possible. (Fig. 66.)

Symptoms and treatment of fracture of the rib.—The symptoms are pain or "stitch" in the side, and some difficulty in breathing. Pain may be especially severe if the patient coughs or sneezes, or breathes deeply. The danger in rib fracture is injury to the lung, and with this complication, there may be spitting up of blood and escape of air beneath the tissues of the chest wall, a condition called *emphysema*. On examination, by passing the fingers along each rib in succession, one will be able to find a local point of tenderness, and often a false point of motion or grating in one or more of them. By placing the ear against the injured side and asking the patient to take a deep breath, grating may be heard distinctly.



FIG. 66.—Fracture of lower jaw, showing loss of alignment of teeth. (Scudder, modified.)

As it is impossible to splint only one or two ribs, in order to immobilize the fracture it is necessary to immobilize the whole side on which the fracture has occurred. This splinting can be temporarily accomplished with a broad binder of muslin, a triangular bandage, or an ordinary roller bandage applied firmly around the chest, but the best method is to strap the chest with adhesive plaster. Procure a strip of plaster wide enough to cover the injured side, about 8 or 9 inches wide, and long enough to extend from the spine behind to just beyond the median line in front, and apply as follows: With the patient standing with arms above the head, tell him to let all his breath out, and as he does this quickly apply the plaster to the injured side, starting just a little to the other side of the spine in the back and bring the strap to just beyond the middle line in front. The plaster is applied at the end of a forced expiration because at this time the broken fragments are more nearly in apposition. In place of a single strip of plaster, several strips, each about two and a half inches wide, may be applied, beginning well below the fracture and gradually working up. Apply each strip with firmness, at the end of a forced expiration, allowing it to overlap one-third of the one below. When there is injury to the lungs accompanied by spitting up of blood, keep the patient quiet in bed and give cracked ice by mouth.

Symptoms and treatment of fracture of the clavicle or collar bone.—In fracture of the clavicle, the attitude of the patient is characteristic; the shoulder drops downward, inward, and forward, and he attempts to support it by holding the elbow of the injured side in the hand of the sound side. The collar bone lying immediately under the skin, the fracture is easily made out from the deformity and localized pain and tenderness. As an emergency dressing until the patient comes under the care of a surgeon, all that is required is a large arm sling with a pad in the armpit and the arm bound to the side. Later treatment, in the absence of a surgeon, consists in the application of any dressing which will keep the shoulder up, back, and outward, thus holding the fragments in their normal position. Many forms of dressing are used for this purpose, especially the Velpeau or Desault bandages or the Sayre dressing. (See section on Bandaging.)

Symptoms and treatment of fracture of the humerus or arm bone.—Fracture of the humerus has all the general signs and symptoms of fracture. A fracture of the neck or upper third of the bone may be put up temporarily by placing a pad or folded towel in the armpit and securing the arm to the side with a bandage; then place a sling about the wrist. With this dressing, the weight of the arm and forearm acts as an extension. Fracture in the middle of the shaft of the bone may be treated by the use of two broad splints, or better, four narrow ones, placed about the seat of injury and secured by a bandage or strips of adhesive plaster, the wrist being supported by a sling. Care must be taken that the splint does not extend too high in the armpit, as thus it might compress the blood vessels or at least be exceedingly painful. A fracture near the elbow

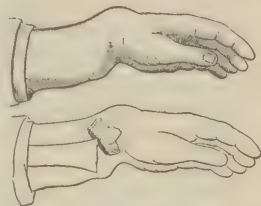


FIG. 67.—Deformity at the wrist consequent upon displacement backward of the lower fragment of the radius after fracture at its lower extremity. (Levis.)



FIG. 68.—Effect upon the lower end of the radius of the cross-breaking strain produced by extreme backward flexion of the hand. (Pilcher.)

joint may be dressed temporarily by simply applying a large arm sling and securing the arm to the body. Fractures in this locality are serious from the liability of the joint to become stiff, and the patient should be brought under the care of a surgeon as soon as possible.

Symptoms and treatment of fracture of the bones of the forearm.—When both bones of the forearm are fractured all the usual signs of fracture are present. When only one bone is broken, the other acts as a splint and but little deformity will be apparent, but there is inability to use the forearm, and on examination, tenderness and a false point of motion can be discovered at the seat of injury. With a fracture of the radius alone, low down and just above the wrist, there is a well-marked deformity, termed silver-fork deformity. (Fig. 67.) A transverse fracture of the radius just above the wrist is spoken of as *Colle's fracture*, and, as the bones are usually impacted, no grating or crepitus is present. (Fig. 68.) The tip (styloid process) of the lower end of the ulna frequently is broken off and there may be rupture of the internal lateral ligament of the wrist. In treating fractures of the forearm, the limb should be put up with the elbow bent at a right angle, the forearm across the chest, with the palm of the hand turned in and thumb pointing upward. First reduce the deformity by gentle traction upon the hand, and then apply two well-padded splints to the seat of fracture, having

them long enough to extend from the elbow to below the wrist; bandage the splints, and support the forearm by means of a sling. It is very important that all cases of Colle's fracture should be brought under the care of a surgeon as soon as possible, as, unless the fracture is properly reduced and treated, the deformity is apt to be permanent.

Symptoms and treatment of fracture of the metacarpals, or wrist bones.—Deformity and pain are the most prominent symptoms. Apply splints on the back and front of the hand, reaching from the finger tips halfway up the forearm.

Treatment of fractured fingers.—If only one finger is fractured, a narrow splint, such as a wooden tongue depressor, should be applied to the palmar surface of the finger and secured by strips of adhesive plaster. If several fingers are broken, it is better to place a pad in the palm of the hand and apply two well-padded splints, extending from below the tips of the fingers well up on the forearm.

Symptoms and treatment of fractures of the pelvis.—The patient is unable to sit up or stand and complains of great pain and a sense of coming apart. Crepitus may be felt on strong pressure. These fractures generally are accompanied with injury to internal organs and more or less shock. With injury to the bladder blood is passed in the urine. When fracture of the pelvis is suspected have the patient lie quietly on his back, apply a tight binder or bandage to the hips, and also fasten the knees together. He should be moved with great care and transported on a stretcher which will not sag. The patient's bed should be fixed so that it will not sag under his pelvis and the thighs should be supported with pillows. In case of bleeding from the bladder, which indicates a rupture of that organ, a catheter should be introduced and left in, so that the urine will not accumulate and escape into the peritoneal cavity. A urinary antiseptic (hexamethylenamine (urotropin)) should be administered by mouth.

Symptoms and treatment of fractures of the femur or thigh.—The patient usually lies with the toes of the injured limb pointing outward; any attempt to move the limbs results in a spasm of the muscles and causes the patient excruciating pain; there is loss of power in the limb, the patient being unable to lift it. On examination, if the fracture is on the shaft of the bone, a false point of motion is discovered. By measurements the fractured limb is found to be shorter than the other one, due to the pull of the powerful thigh muscles. Measurement should be made on each limb and compared by stretching a string from the anterior superior spine of the ilium to the internal malleolus with the patient on his back. Emergency treatment consists in applying two splints, one on the outside reaching from the armpit to beyond the foot and one on the inside from the crotch to the foot. The splints should be tied in five places—around the ankle, over the knee, just below the hip, around the pelvis, and just below the axilla. It is well also to tie the two limbs together. The patient must be brought under the care of a surgeon as soon as possible, as an anæsthetic is frequently necessary to effect reduction, and a traction splint or other means of extension is generally required.

Symptoms and treatment of fracture of the patella or knee cap.—In the fracture of the patella, the patient can not stand or walk, the upper fragment is drawn up to the thigh by the powerful muscle attached to it, and the gap can be felt readily; the joint swells up at once. Put the limb up straight with a well padded splint behind the thigh and leg. The two fragments can be brought together by strips of adhesive plaster, one strip passing above the upper fragment, and the other below the lower one, or in place of the adhesive plaster a figure-of-eight bandage may be applied. The patient should be put to bed with

the injured leg elevated on a pillow, and ice should be applied to the joint with the object of limiting and decreasing the swelling. Place the patient under the care of a surgeon as soon as possible.

Symptoms and treatment of fracture of the leg.—When both bones of the leg are broken, the usual signs and symptoms of fracture are present. These fractures often are compound. If only one bone is broken, the other acts as a splint and deformity will not be so marked, but there will be present a local point of tenderness, swelling, and probably discoloration of the skin. Fracture of the lower end of the fibula is spoken of as *Pott's fracture*. (Fig. 69.) Pott's fracture generally is accompanied by tearing of the internal lateral ligaments of the ankle joint or by a fracture of the internal malleolus, in which case there is great deformity and turning out of the foot. In case it is purely a fracture of the lower end of the fibula, there may be few of the usual signs of fracture and the injury may be mistaken for a sprain. For treatment of fractures of the leg, reduce any deformity by traction in the long axis of the limb, and then apply three well-padded splints, two side splints, and a posterior one (in case of Pott's fracture, do not apply a posterior splint). The latter is to give support and prevent a backward sagging at the seat of fracture. A pillow and two side splints also make an excellent temporary dressing; a pillow covered by a pillow case is placed upon the deck, and the injured leg is laid carefully upon it; the edges of the pillow then are brought up around the foot and limb and are pinned in place; finally the two side splints are applied outside the pillow and are secured in place by straps of adhesive plaster or strips of bandage.

Treatment for fracture of the foot.—Apply a light splint to the sole of the foot, and keep it immobilized by two side splints extending up each side of the leg from below the foot. Place the patient under a surgeon's care, so that a plaster of Paris bandage may be applied.



FIG. 69.—Pott's fracture.

INJURIES DUE TO HEAT AND COLD.

Injuries due to heat are classified into the *general* or constitutional, including heat stroke or sunstroke and heat exhaustion; and *local*, including burns and scalds.

Heat stroke, sunstroke, or insolation is due to prolonged exposure to excessive heat, usually to the heat of the sun. It may, however, occur in hot rooms, particularly in firerooms aboard ship. Exhaustion and improper clothing preventing the proper elimination of heat from the body surface are powerful contributing factors; hence this condition is especially apt to occur to men on the march, particularly when marching in close formation. The warning symptoms are headache, dizziness, irritability, frequent desire to urinate, and seeing things red or purplish. With or without these symptoms, the patient suddenly falls unconscious; the skin is dry and intensely hot; pupils contracted; pulse full and strong; respirations snoring: there may be convulsions; if the temperature of the body can be taken it usually will be found to be very high, 105° to 109° F., or higher. The condition is very serious, and unless imme-

diately relieved terminates in death. The *treatment* has for its object the rapid reduction in temperature. The patient should be brought to the coolest accessible spot, in the shade, if out of doors; on deck if in the fireroom of a ship; the clothing removed; an ice bag applied to the head and cold water poured over the patient continually. At the same time, the body may be rubbed with ice, and if a tub is available, immersed in cold water. The treatment should continue until the temperature is reduced. If the patient is able to swallow, cold, not iced, water should be given to drink, and this should be repeated as often as possible. Serious results are liable to follow a sunstroke, even when death does not occur; the most common of these after effects are permanent headache, paralysis, mental confusion, or even insanity. Moreover, one who has had a sunstroke is ever after very susceptible to the action of the sun.

Heat exhaustion is due to the same causes as heat stroke. Under the same conditions, one man may get heat stroke, while another gets heat exhaustion. The warning symptoms are dizziness, often with nausea and vomiting associated in some instances, particularly in firerooms aboard ship, with cramps in the muscles. The patient suddenly falls; is not unconscious and may be easily aroused; temperature is subnormal; the face is pale, skin cool and moist; pupils dilated or normal; pulse very weak; respirations shallow, perhaps sighing; and perhaps one or several sets of muscles in painful contraction. In this condition of heat exhaustion certain muscles or groups of muscles frequently are thrown into violent contractions which cause excruciating pain. This condition is relieved by hot applications, immersion of the part or the person's body in a hot bath, or by the administration of an opiate (hypodermic injection of morphine). The *treatment* for heat exhaustion consists in moving the patient into the shade or on deck, loosening the clothing, keeping the head low, and giving water and some stimulant, such as hot coffee or aromatic spirits of ammonia. After removal to sick bay or hospital, he should be kept perfectly quiet in bed with hot-water bottles and blankets around him if necessary.

Burns and Scalds.

Burns are produced by a flame, hot solids, hot fluids, caustics such as strong acids and strong alkalies, wires charged with a heavy electric current, sun's rays, and X-rays; *scalds* are produced by hot liquids. Burns and scalds differ only in that with the former the hairs are removed, whereas in the latter they are not; the treatment is the same for both. Burns usually are said to be of the first, second, and third degree; those which cause merely redness are of the *first degree*; if blisters are raised, they are of the *second degree*; if there is charring and destruction of tissue, the burn is of the *third degree*. The symptoms of burns are shock, which may be profound; chilly sensations, and pain; the pain may be agonizing or slight. The result of the burn depends more upon the extent of surface affected than upon its depth, a burn of the first degree being almost fatal if two thirds of the body surface be affected, and one of the second degree if one third of the body is burned. The chances of recovery are much less in children and elderly people. With extensive burns of the body surface, the danger in the first 24 hours is from shock; after that from internal congestion and inflammation, suppression of urine from nonfunctioning of the kidneys, ulcerations of the duodenum, intestinal hæmorrhage, and finally exhaustion or infection. If the entire thickness of the skin is destroyed, terrible deformities are apt to follow the contraction of the skin which follows healing. As the result of inhalation of live steam from bursted steam pipes, the respira-

tory tract may suffer from burns, causing death in many instances from suffocation or shock. X-ray burns are particularly slow in healing.

The *treatment of burns* is both *constitutional* and *local*. The constitutional treatment consists in the treatment of shock and pain, on the one hand, and, on the other hand, in measures to prevent suppression of urine, in combating the toxemia and the effects of infection, etc. In addition to local measures for the treatment of pain, the administration of morphine, one-fourth grain, hypodermically, is frequently necessary. The bowels must be kept open, and plenty of water given by mouth, and also at times by rectum, so that the kidneys will continue to act. The smaller the area of body surface burned the less necessity is there for constitutional treatment. The object of the local treatment is to remove the cause, to allay pain, prevent infection, and promote healing. The deeper the burn, the more important do the methods for the prevention of infection become, and vice versa. The greatest factor in the causation of pain in burns is the movement of air over the inflamed area, and therefore local treatment in first-degree burns consists in the covering of the burned surface with a film of oil. If the burn has been caused by a caustic such as an acid or an alkali, before the film of oil is applied the acid must be neutralized with bicarbonate of soda or ordinary baking soda, and the alkali by a weak solution of acetic acid or ordinary vinegar. To cover the burned surface with a film of oil, any fresh, bland oil, such as cream, vaseline, liquid petrolatum, or olive oil will answer the purpose. In burns of the second and third degree the quickest temporary means of excluding air is to immerse the part or the entire body in warm water; then, having everything in readiness, carefully cut away the clothing, leaving such as may be sticking to the burned skin; blisters should be left undisturbed unless they are very tense and painful, when they may be punctured by a sterilized needle, and the content allowed to escape. The wound next should be cleansed carefully and dressed with sterile gauze dipped in warm Dakin's solution, or a solution of boric acid, or picric acid (10 parts in 80 parts of alcohol and 1,000 parts of sterile water); and over the gauze place a thick layer of sterile absorbent cotton. When the burns are extensive, small portions only should be exposed and dressed at a time. When the first dressing is finished it should be kept moist with the antiseptic solution, and left on as long as possible. The ambrine treatment for burns may be used in first and second degree burns, if on hand. Ambrine and its substitutes consist of paraffin and resin of such consistency that they remain liquid while hot, and solidify on cooling. The burn first is covered with a film of liquid petrolatum (preferably sterile), the ambrine is melted and cooled to about 100° F., and applied with a brush or preferably a sprayer. Place the patient under the care of a medical officer as soon as possible.

In rendering first aid at a fire the points to be kept in mind are: (1) Prevent drafts from fanning the fire. Shut and keep shut all doors and windows. If one's own clothing catches afire, do not run, as this fans the flames; lie down on the deck or a bed and roll up as tightly as possible in a rug, shawl, overcoat, blanket, or other woolen cloth, leaving only the head out; if nothing can be obtained in which to wrap up in, lie down and roll over slowly, at the same time beating out the fire with the hands. If another person's clothing catches afire, throw to the ground and smother the fire with a coat, blanket, rug, or the like; in doing this care should be taken to stand at the head, and, holding down with one foot one edge of the blanket or whatever is used, to throw it toward the feet of the individual; the flames thus are swept away from the rescuer and from the face of the burning person. (2) Remember that the air within 6

inches of the deck is free from smoke, so when unable to breathe a rescuer should crawl along the floor with the head low, dragging anyone who has been rescued behind him. The rescuer should tie a wet handkerchief or cloth over the mouth and nose to minimize the danger of suffocation.

Cold or chilling.

Injuries due to cold are classified as *general*, or constitutional, not *local*.

Prolonged exposure to extreme cold results in a general depression or lowering of the vitality, a gradual chilling of the body, and a congestion of the internal organs. The body and limbs first feel numb and heavy, and then become stiff; drowsiness and an irresistible desire to sleep take hold of the individual. If left alone, unconsciousness rapidly follows. When found in such a condition, life not yet being extinct, one should be taken into a cold room, all clothing removed, and the body rubbed briskly with sheets or towels wet with cold water. As soon as the stiffness is removed artificial respiration should be performed; and when the patient is able to swallow warm drinks should be given. When there are signs of returning consciousness and circulation the body may be enveloped in a blanket and the temperature of the room gradually raised. The reason why a frozen person must not be removed to a warm room is that the sudden restoration of the circulation gives rise to violent congestions and often to sudden death from the formation of clots in the blood vessels.

In intense cold, frostbite not infrequently occurs without one's knowing it, but usually the ears, fingers, etc., become painfully cold, and then one suddenly realizes that no longer is there any feeling in the parts. The color of the frozen part is white or grayish white. The object of treatment is to bring the frozen part *gradually* to its normal temperature. The danger of sudden thawing is congestion and bursting of the capillary walls which have been weakened by freezing, and resulting in gangrene or death of the part; therefore the patient should not go into a warm room or near a fire. Rub the part vigorously with wet snow or ice-water; never with dry snow, as the temperature of the dry snow may be much below freezing and rubbing with it would aggravate the condition. When the pain and redness return use warm water gradually. *Chilblain* is a condition of acute or chronic congestion occurring especially in the feet and due to bringing cold feet near the fire too suddenly or merely following exposure to cold in persons with poor circulation. On the part affected are red spots, more or less swollen, which burn and itch intensely. The treatment consists in stimulating applications, such as liniments and tincture of iodine. Susceptible persons should wear woolen socks.

REMOVAL OF FOREIGN BODIES.

Either *inanimate objects* such as splinters, cinders, marbles, peas, beans, etc., or *animate objects* such as insects, maggots, ticks, etc., may gain access to the tissues and cavities of the body. With regard to the removal of inanimate foreign bodies, if their removal is difficult or liable to be attended with much damage to the tissues, the patient should be brought under the care of a surgeon as soon as possible for the removal of the foreign body. If the services of a medical officer are not to be had for some time, then the first-aid man must be guided by the probable relative benefit to the patient of having him wait the required time for expert treatment or of doing the operation himself. The main principle to be kept in mind in the removal of an inanimate foreign body is to avoid infecting the tissues, by using sterile appliances, and to do as little damage to the tissues as possible. The main principle underlying the treatment of conditions where insects, etc., have gained access to tissues and

cavities of the body is to kill the object first and then remove it. Creatures such as insects and ticks are best killed by putting some bland oil, such as olive oil or liquid petrolatum, into the cavity to which they have gained access, the oil covering over their breathing pores and thus suffocating them, after which they may usually be easily washed out.

Foreign bodies in the eye.

Foreign bodies, such as particles of dust, cinders, etc., may lodge under the lids, upon the conjunctiva, or upon the cornea. In the latter situation they are seen and removed with the greatest difficulty, and the removal ordinarily should not be attempted by other than a medical officer. To remove a foreign body from the eye, the best improvised article and the one that nearly always is at hand is a match. Light a match and after it has burned a moment, blow it out; then with a clean handkerchief and a circular movement of the fingers, wipe off the charred end, leaving a soft, clean, splinterless point with which to remove the foreign body. *To examine the lower lid*, draw it down with the fingers, at the same time letting the patient look up; if the foreign body is not found there, *evert the upper lid* by standing behind the patient with the head upon your chest, and telling the patient to look down; at the same time press a match or the end of the finger firmly against the outside of the lid about a quarter of an inch behind its margin. Draw the lid down by the lashes, and turn it upward and outward over the match or finger tip. If the particle still is not visible, search the ball of the eye carefully for it, and when it is found, lift it off gently by a quick movement with the point of the match. If the eye is very irritable, it may be necessary to put in a few drops of 2 per cent cocaine solution. It is important to remember that even after a foreign body is removed from the eye there is often for some time a sensation as if it were still there. Instill a few drops of 5-10 per cent silvol and irrigate the eye with boric solution.

Foreign bodies in the ear.

The foreign body may be an insect, a pea, a grain of wheat, a pebble, a plug of hardened wax, etc. An insect in the ear by its movements and buzzing often causes the most intense annoyance. Hold the head over on one side with the ear containing the insect uppermost; drop in 5 or 10 drops of bland oil, such as olive oil or liquid petrolatum, and then syringe the ear. If the foreign body is vegetable, such as a pea, water should not be used, as it may cause the pea to swell and thereby render its extraction more difficult. If the pea is visible, bend the loop of a fine hairpin and try to get beyond it so as to hook it out. As there is always danger of injuring the drum when instruments are pressed into the ear, it should be a guiding rule that no instrument should be passed beyond the point where its tip can be seen. *Hardened wax* may be softened with a few drops of hydrogen dioxide, then removed by syringing with a warm 5 per cent solution of soda.

Foreign bodies in the nose.

Children and insane persons often push peas and other foreign bodies into the nose, and occasionally flies deposit their eggs there, with the result that maggots develop in the nasal cavity. Foreign bodies are best removed by closing the free nostril with the finger and forcibly blowing through the obstructed side; snuffing a little powdered tobacco or pepper will cause sneezing and aid in the expulsion; if this does not succeed and the body can be seen, it may be hooked out with a bent hairpin in the same manner as described for the ear; or, finally, a small smooth stick or a slender pencil may

be wrapped with a little cotton and used to push the foreign body gently back through the posterior nares into the mouth; press straight backward, never upward. The presence of maggots in the nose is a very serious condition, which may result in death. Let the patient inhale through the nose a half-teaspoonful of chloroform, and while the maggots are stupefied, syringe them out with warm normal salt solution.

Foreign bodies in the throat.

Foreign bodies in the throat are usually bones or masses of food. If the bone can be seen and reached it may be removed by fingers or forceps; if not, it may be carried down by eating dry bread. If the obstruction is a mass of food it may be dislodged by forcible blows on the back between the shoulders or the fingers may be passed into the throat to hook it out or to cause its ejection by vomiting. Foreign bodies in the air passages cause violent cough and difficult breathing; the case is urgent, and in the case of a child, he may be held up by his heels and shaken; if an adult, inversion also may be attempted, and the case treated as described for foreign body in the throat.

Foreign bodies in the stomach.

Foreign bodies sometimes are swallowed and reach the stomach and intestines. Such cases are not usually serious. If the body is angular or pointed, such as a tack or pin, feed the patient on substances which leave considerable residue to cover and protect the sharp points—potatoes, bananas, bread, etc. Do not give laxatives, as they will render the movements liquid, and thus leave sharp points exposed and because the increased peristalsis favors injury to the intestinal walls. The patient should, however, be brought under the care of a surgeon.

Foreign bodies in the skin.

Here we find splinters, thorns, needles, pins, fishhooks, pieces of glass, gunpowder, etc. For splinters and thorns pass the point of the blade of a pocketknife under them; with the thumb-nail press the splinter against the blade and draw it out; or use a pointed dissecting or dressing forceps. If the splinter is buried, open up the skin a little with the point of a knife or a needle until it can be reached; if under a nail, cut a notch in the nail so as to expose it. If a needle or a pin is broken off in the skin and can not be grasped with forceps, cut a small hole in the end of a cork and press it down over the point of entrance of the needle; this may cause the needle to emerge so far that it can be grasped. The needle may be so situated that it is best to push it through and extract it on the other side. If the needle or pin is in the foot or the hand and can not be extracted, the patient should be directed not to use the part, as muscular action will cause it to work in deeper. A fishhook or an arrow can not be drawn out on account of the barbs; they must be pushed through. Gunpowder is removed best by a thorough scrubbing with soft soap and a stiff brush, the remaining grains being picked out with a needle.

SUFFOCATION OR ASPHYXIA.

Asphyxia or *suffocation* is a condition where breathing or respiration has ceased due to the lack of the proper supply of oxygen in the lungs, or due to a condition in the blood rendering it unable to absorb oxygen from the lungs. Suffocation may be caused by stoppage of the air passages mechanically, as by water in drowning; by a foreign body; by a diphtheritic membrane, extending into the larynx; by a tumor; by a constricting band around the neck; and by

a swelling of the mucous membranes, such as sometimes follows the inhalation of live steam or irritating gas such as chlorine. It may be due to the air we breathe having its oxygen content replaced by some other gas or by the air we breathe containing a gas which by its action on the blood renders it incapable of taking on oxygen during its circulation in the lungs (carbon monoxide).

Treatment for suffocation or asphyxia.

First, remove the cause of the suffocation, then establish natural breathing by means of artificial respiration, and later treat the shock.

Artificial respiration.—There are several accepted methods of applying artificial respiration. Do not rely upon any special apparatus, as it is frequently out of order and not available when most needed. The so-called *Schaeffer's* method of artificial respiration is probably the best all around method and is applied as follows: The patient is placed face downward with a roll of clothing under the chest, and the face, properly protected, turned to one side. The operator kneels astride of the patient's thighs, facing toward the head, and places his hands on the lower part of the thorax with his fingers spread over the lowest ribs. Then with the arms held straight, press upward and inward, bringing the whole weight of the operator against the chest. (Fig. 70.) This compresses the lower part of the chest and abdomen,



FIG. 70.—Expiration; pressure on.
(Keen.)



FIG. 71.—Inspiration; pressure off.
(Keen.)

forcing out the air and producing expiration. After two or three seconds the pressure is released by swinging backward, but the operator's hands are not removed from the patient. This permits the chest wall to expand and produces inspiration. This alternate compression and release of the chest should be applied about fifteen times a minute. (Fig. 71.)

Artificial respiration may be required in those persons apparently drowned; asphyxiated by gases, fumes, or noxious vapors, and anesthetics; electric shock; shock or collapse; freezing or exposure to extremes of heat or cold; cases of poisoning, etc.; in other words, in all cases in which breathing is temporarily suspended. The symptoms by which we may recognize the necessity for artificial respiration are: cyanosis (blueness of the skin and membranes); suspension of respiration; or shallow breathing in some cases of poisoning. Artificial respiration should be continued for at least two hours before giving up hope for the revival of the patient.

Treatment for a person apparently drowned.—Every minute and second counts, so waste no time. Have bystanders move away to give the victim all the air possible. Loosen clothing about neck, chest, and abdomen. With handkerchief or towel in hand, gently swab out the mouth and throat to remove mud or mucus. Turn the patient over, face downward, place the hands under the abdomen, one on either side, and lift the patient, in an endeavor to drain the lungs and stomach, then with a large roll of clothing under the abdomen, and by making firm pressure upon the loins, continue the effort to expel the water

from the lungs and stomach. If the individual then does not breathe, proceed immediately with artificial respiration. It is well at the same time to try to stimulate respiration by having an assistant hold ammonia or smelling salts to the nostrils. Recovery from drowning has occurred where persons have been submerged for some minutes; the statements of observers as to length of time of immersion can never be accepted, as in emergencies of this sort minutes seem like hours. When breathing has become established, remove wet clothing and treat the shock.

Treatment for a person suffocated by hanging or by strangulation.—Promptly remove any constriction from the neck and also clothing from around the chest. Attempt to excite breathing by dashing cold water on the face and body; if this fails, proceed with artificial respiration.

Treatment for a person suffocated by choking.—The choking may be due to a foreign body or to such a thing as a diphtheritic membrane. Make an attempt to remove the offending material as described in a previous paragraph. In many of these cases it will be necessary to do a tracheotomy; that is, cut a hole in the windpipe, or in diphtheritic cases, either an intubation or tracheotomy. This, however, must be done by a surgeon and no time whatsoever must be lost in bringing the patient under his care. After removal of the obstructing material, perform artificial respiration in the manner described above.

Treatment for the most common type of suffocation from poisonous gases.—Poisoning from illuminating gas and from breathing the exhaust gases from gasoline engines are the most common types of gas poisoning. It is the carbon monoxide in these gases which is responsible for the damage. When carbon monoxide is in sufficient concentration in the air we breathe it forms a stable compound with the hæmoglobin of our blood; this prevents the hæmoglobin from taking up oxygen and carrying it to the tissues. The patient must be removed as soon as possible into the fresh air, and artificial respiration instituted. In the meantime send for a physician, as it often becomes necessary to let out some of the patient's blood and substitute therefor good blood from some one else (*transfusion*). A person poisoned with carbon monoxide presents a cherry red appearance on cheeks and lips.

UNCONSCIOUSNESS.

Insensibility and unconsciousness are one and the same thing. There are varying degrees of unconsciousness, and the same agent causing partial unconsciousness, if further applied, may cause total unconsciousness. There are numerous causes for unconsciousness, and in order to properly treat it the cause must be discovered. To treat a case of unconsciousness is one of the most difficult things that may fall to the lot of the first-aid man. In all cases of unconsciousness strenuous efforts should be made to bring the patient under the care of a medical officer as soon as possible. To ascertain the cause of unconsciousness, the first-aid man should be very observant of the surroundings as well as of any evidence on the person of the patient which might give a clue to the cause. If there are any observers on the ground or any who are acquainted with the patient's habits and past history, all information possible should be obtained from them. The patient's body should be examined for evidences of injury, bleeding, or paralysis. It should be noted whether the skin is moist and cold or hot and dry. The character of the respirations should be noted, whether deep, strong, and fast, or whether weak, shallow, and slow. It should be noted whether the pulse is weak and shallow, or whether it is bounding and strong. The condition of the pupils should be noted; whether they

are even or uneven, dilated or contracted. The breath should be smelled for evidence of alcohol, and a note made whether there is frothing at the mouth or injury to the tongue. The common causes for unconsciousness are suffocation, bleeding, shock, electric shock, heat exhaustion, freezing, sunstroke, epilepsy or fits, apoplexy and injury to the brain (concussion and compression), alcoholism and certain other poisons, hysteria, and uræmia. For the symptoms and treatment of suffocation, bleeding, shock, heat exhaustion, sunstroke, and freezing, see previous paragraphs, and for symptoms of poisoning see chapter on Toxicology.

Electric shock is caused by coming in contact with a "live wire"; spasmodic contraction of the muscles occurs so that the person can not let go. Depending on the strength of the current in the wires in contact with the patient, sudden death or insensibility, with or without severe burns, may be caused. The first thing to be done is to rescue the patient by setting him free from the wire, and this must be done with great care, as to touch him with bare hands will cause the rescuer to get the same shock. With a simple quick motion, free the victim from the current. Use any *dry nonconductor* (clothing, rope, board) to move either the victim or the wire. Beware of using metal or any moist material. While freeing the victim from the live wire have every effort also made to shut off the current quickly. Immediately start artificial respiration, and when voluntary breathing returns, treat for shock. The burns must be treated as other burns. Lightning stroke causes similar symptoms to the above and the treatment is the same.

Epilepsy or fits.—In epilepsy there may be fits with insensibility, or a mere momentary unconsciousness with slight muscular twitching, but in which the patient does not fall. In the severe form, with or without warning signs, the person suddenly cries out in a peculiar manner and falls in a fit; at first the entire body is rigid, then there are general convulsions with jerking of the limbs, contortion of the face, and foaming at the mouth. After a few minutes the convulsions are followed by profound stupor, and this generally passes off into a deep sleep. During the attack the eyeballs may be touched without the patient flinching, the pupils are dilated, the patient often bites his tongue, and there may be involuntary evacuations of the bowels and bladder. Epileptic unconsciousness may be distinguished from other forms by the history of the fit, and of other previous fits, by the foam at the mouth and the bitten tongue and by the absence of any paralysis. As far as *treatment* goes, nothing can be done to stop the fit or to control it; all that can be done is to prevent the patient from hurting himself and to make him as comfortable as possible; do not attempt to hold him, but twist a handkerchief, passing it between his jaws, and tie it at the back of the neck until after the fit is over to keep him from biting his tongue. After the fit is over let the patient sleep as long as he will. One must be on the lookout in the service for men feigning epileptic fits in order to obtain a discharge. The feigned attacks usually occur at night when no one can see them; the man does not fall so as to hurt himself, does not bite his tongue, flinches when the eyeball is touched, the pupils are not dilated, and the patient can be aroused. When there is foaming at the mouth a piece of soap often will be found inside the mouth. A pail of cold water suddenly thrown upon the man's head and shoulders usually makes the diagnosis; it promptly revives the malingerer, but has little or no effect on the epileptic.

Concussion of the brain.—Concussion of the brain is the condition present when a man has been "knocked senseless" or "stunned." It is a jarring and shaking of the brain due to blows or falls upon the head or falls upon the

feet; the brain almost stops working for a time. The symptoms are unconsciousness, pallor of the face, breathing so quiet and shallow that it hardly can be detected, pulse fluttering, pupils equal and usually contracted. The degree of insensibility varies. Sometimes the patient can be aroused, but is irritable, and lapses again into unconsciousness which may last minutes or hours. Vomiting and turning on the side are favorable symptoms. The *treatment* consists in perfect rest in a dark, quiet room; warmth applied externally if the surface is cold; and aromatic spirits of ammonia by inhalation if there is much depression.

Compression of the brain and apoplexy.—Compression of the brain is, as its name implies, a pressure on the brain. This pressure is due usually to either a piece of bone or to hæmorrhage from a torn vessel within the cranium, and as the blood can not leave the cranial cavity it compresses the brain. This compression prevents certain parts of the brain from working. When the bleeding is the result of injury the condition is called *compression* of the brain; when it is the result of the bursting of a diseased blood vessel without any violence it is called apoplexy; the result and the symptoms are practically the same. The symptoms of compression are profound unconsciousness; loud, snoring breathing; slow pulse; pupils usually unequal and not reacting to light; and usually paralysis on one side of the body. If the compression is due to a piece of broken bone, the symptoms come immediately after the injury, while if it is due to bleeding they may come on later and gradually. The *treatment* of apoplexy consists of keeping the patient absolutely quiet, at rest in a comfortable position, and applying cold applications to the head during the acute stage. *Do not administer stimulants.* When convalescent, regulate diet, recommend a very moderate amount of exercise, and instruct the patient to avoid worry and excitement.

Hysterical unconsciousness.—Hysteria is a disease of the nervous system accompanied by loss of control over the emotions. It usually is seen in women, but also may be present in nervous men. The disease is manifested in a great variety of ways, but the only form we shall consider is that accompanied by convulsions. In this form hysteria may closely resemble epilepsy. The patient usually has an attack of laughing and crying and gradually "works himself up" to such an extent that he falls in a convulsion. The attacks sometimes are prolonged for several hours, and, upon recovery, it is not uncommon to find the patient laughing or sobbing for some time after. He appears to be unconscious, but in falling he always picks out some soft spot or chair to fall upon, and is careful not to injure himself. The tongue rarely is bitten in hysteria. Hysteria may be mistaken for epilepsy, but in the latter condition the fall is sudden, and the sufferer frequently receives painful scalp wounds or injuries to the tongue. While hysteria is a disease, the patient nevertheless should be treated with firmness. The subjects usually crave sympathy. To sympathize with such a patient is the worst possible thing and simply prolongs the attack or hastens another. The best thing to do is to leave the patient alone—of course seeing that no harm can come to him. When he recovers and finds himself alone and without sympathy it is not likely that he will repeat the attacks. In prolonged convulsions, throwing water in the face usually will terminate the seizure.

Uremia or the insensibility of Bright's disease.—The insensibility of Bright's disease is really an acute poisoning from the retention of the waste products which the diseased kidneys are not able to eliminate. The unconsciousness often is attended with delirium and convulsions. The pupils are contracted,

the pulse is slow, there is a peculiar odor of the breath, and the breathing is loud and snoring. The distinguishing characteristics are the history of Bright's disease, the waxy color of the skin, sometimes dropsy, abnormal urine (albumin, casts, etc.), the equally contracted pupils, and the absence of paralysis. *Emergency treatment* consists in applying cold cloths to the head and a hot mustard poultice to the back of the kidneys. If the services of a medical officer are not available within a brief period of time, catheterize, and give an enema and a hot pack.

Unconsciousness caused by acute alcoholism.—The use of alcohol, if carried to excess, produces a condition of unconsciousness which is very likely to be confounded with other allied conditions. Too great care can not be taken in examining these cases thoroughly, as mistakes are of frequent occurrence, and cases of fractured skull or apoplexy often are pronounced mere alcoholism. Do not be led astray by the fact that a person has an odor of liquor about him. He may have been drinking and had a stroke of apoplexy, or may in falling have fractured his skull. If there is the least doubt, it is better to give the patient the benefit than to run any risks. A person suffering from alcoholic coma lies in a supor, but usually can be partially aroused and made to answer questions. The face is flushed, the pulse is full and rapid, and the respirations are deep. The pupils usually are dilated and the breath has the heavy odor of alcohol. Ordinary intoxication rarely requires any treatment besides rest and sleep. If the patient is in an exhausted state, it is well to wash out the stomach, then cover him warmly and apply heat to the extremities. If coma is present, try to arouse the patient by cold douching or striking with wet towels. If the pulse is weak, stimulants should be given; inhalations of ammonia and the internal use of strychnine or caffeine may be employed if the patient is conscious. The use of strong coffee by the rectum is of great service. (Treatment of methyl (wood) alcohol poisoning is described in the chapter on Toxicology.)

When unable to diagnose exactly the cause of unconsciousness determine, if possible, that it is due neither to a poison, to bleeding, nor to sunstroke, for each of these demands immediate special treatment, nor to suffocation, for which it would be necessary, of course, to give artificial respiration. Then, unless it is necessary to give the special treatment, if the patient is pale and weak, have him lie down with his head low and warm and stimulate him in every way possible; on the contrary, if the face is red and pulse is very strong, while the position for the patient should also be lying down, the head should be raised. No stimulants should be given in the latter condition, and cold water should be sprinkled on the face and chest.

ACUTE ABDOMINAL CONDITIONS.

The most common serious acute abdominal conditions are acute appendicitis, perforating ulcers of the stomach or duodenum, intestinal obstruction, gall-stone colic, kidney-stone colic, and poisoning by infected food or by other poisons. Pain and tenderness in the abdomen, general or localized or both, nausea and vomiting, and more or less shock are symptoms common to these conditions. Beginning pneumonia, lead poisoning (painter's colic), and inflammation of the testicle are conditions outside of the abdomen which may produce similar symptoms. Acute indigestion and constipation are comparatively mild conditions which may be confused with these conditions.

Many cases of acute appendicitis, obstruction of the bowels, and acute pancreatitis have been diagnosed as acute indigestion or constipation, resulting in the death of the patient. All cases presenting symptoms of abdominal pain or

nausea and vomiting, particularly when associated with more or less shock, should be brought under the care of a medical officer as soon as possible, as time is a very important element in averting a fatal end in many of these conditions. One always should suspect something more than ordinary indigestion or constipation if there is much prostration, shock, or elevated temperature, or *if the symptoms persist for any length of time*. Many a person suffering from acute appendicitis or obstruction of the bowels will ascribe the condition to something that has been eaten, but do not be deceived by such a statement. Get all the information possible as to how the attack started, history of previous attacks, and symptoms prior to the present attack, whether the patient has vomited blood or not, and when the bowels last moved; take the temperature and pulse rate; lay the patient flat with the abdomen bared and determine by gentle and careful palpation where the pain and tenderness are most marked. Make a white blood count if possible.

Acute appendicitis.—Appendicitis is an inflammation of the appendix. A patient frequently complains for several days before the attack of indigestion, loss of appetite, constipation, or diarrhoea and uneasiness in the abdomen, or the attack may come on suddenly. The pain may start in the pit of the stomach, then become generalized over the abdomen, and, finally after several hours, become localized in the right lower quadrant of the abdomen with marked tenderness on pressure and rigidity of muscles over that point. Vomiting generally comes on three or four hours after the beginning of the attack. The temperature may be subnormal from mild shock or be elevated to 100° or 101° F. There is generally an increase in white blood cells to above 10,000 per cubic millimeter. In acute appendicitis the appendix becomes full of pus and the danger lies in its rupture with resulting peritonitis. Many cases never rupture, whereas others often rupture in three or four hours after the attack starts. The object is to remove the appendix before its rupture, as otherwise death may ensue from peritonitis, or the abdomen may have to be drained for months with or without final recovery and perhaps resulting in the formation of adhesions, making the patient more or less of a permanent invalid. The *treatment* consists in placing the patient under the care of a surgeon as soon as possible. In the meantime put to bed, giving nothing by mouth, not even hot water; give a soap and water enema very low and under very little pressure, and put a hot-water bag over the appendix. Do not use an ice bag. In case no medical officer is available for some time, liquids in small amounts may be given after 48 hours. *Never give a cathartic to a person suspected of having acute appendicitis.*

Acute intestinal obstruction.—In this condition, a loop of bowel becomes constricted, resulting in the inability of the intestinal contents to move beyond the point of constriction and cutting off the blood supply to this loop of the bowel with resulting gangrene or death to the bowel. This condition is followed by absorption of poisons from the intestines, peritonitis, and death if the condition is not relieved. Two very common ways for the bowel to become constricted are by means of adhesions within the abdomen and by a loop of bowel becoming strangulated in a hernia, or rupture, as it is commonly called. The symptoms are inability to pass gas or faeces by the rectum, pain in the abdomen, vomiting becoming more and more frequent, and violent shock. The abdomen may be distended above the point of constriction and be flat below that point. There is generally a leucocytosis as in appendicitis. The loop of bowel must be relieved of its constriction or death will ensue. Place the patient under the care of a surgeon at the earliest possible moment. In the meantime, take the following measures: (1) If the obstruction is due to a strangulated hernia, and the case

has not gone too far, put the patient in a hot tub with the buttocks elevated in order to relax the inguinal ring, and exert gentle pressure over the tumor. (2) Put the patient to bed, give a soap and water enema, and nothing by mouth. *Never give a person suspected of suffering from obstruction of the bowels a purgative.*

Perforated gastric or duodenal ulcer.—Generally, though not always, a person suffering from perforated ulcer of the stomach or duodenum gives a long history of stomach trouble. Acute pain “in the pit of the stomach,” associated with more or less shock, is suddenly felt. The pain is sudden and intensely violent, which is greatly increased by swallowing fluids, by vomiting, by turning the body, by cough, by respiration, and by pressure. This pain may radiate throughout the abdomen, but the chief tenderness is in the region of the stomach. Vomiting occurs in about one-half the cases at the time of perforation. Shock may be severe following the perforation, but, as a rule, does not last long. A boardlike rigidity of the muscles of the abdomen is present, and the temperature is usually normal or subnormal. The danger from perforated ulcer of the stomach or duodenum is peritonitis, due to the escape of stomach or duodenal contents into the peritoneal cavity. The *treatment* consists in bringing the patient under the care of a surgeon as soon as possible before peritonitis sets in; in the meantime, put the patient to bed, *give absolutely nothing by mouth* and put an ice bag over the stomach; and treat shock and hemorrhage if present.

Gall-stone colic.—Gall-stone colic is due to the passage, or the attempt at passage, of a gall stone from the gall bladder to the intestines. Depending on the location of the stones, a person with gall stones may or may not be jaundiced. The patient frequently gives a history of stomach trouble with or without jaundice and may give a history of previous gall-stone colic. The colic consists of spasmodic, excruciating pain over the stomach and liver, radiating upward over the right half of the thorax, frequently up under the right shoulder blade. The patient is very nauseated, and usually vomits, and often the vomiting is violent. The abdomen is distended and a condition of collapse soon comes on. The respirations are shallow, the patient groans, cries out, or flings about the bed, often assuming strange contorted positions, trying to obtain relief, frequently holding one hand over the liver region. The pain is one of the most excruciating a human being can experience. The usual duration of an attack is from 4 to 20 hours, although it might last much longer. The temperature is usually normal or subnormal. The patient should be brought under the care of a medical officer as soon as possible. If one is not at hand, give one-fourth grain of morphine hypodermically, followed in an hour by another one-fourth grain, and place a hot-water bag over the liver at the lower border of the ribs.

Kidney-stone colic.—This condition is due to a small stone from the kidney entering into the ureter, which it blocks, tears, or distends. The pain is gradual or sudden in onset, is fearful in intensity, and runs from the lumbar region down the corresponding thigh and testicle and into the abdomen and back. There are nausea, vomiting, collapse, and sometimes unconsciousness or convulsions. Frequent attempts at urination result in pain but little urine. The urine is often smoky or red from injury to the ureter. After a time the pain vanishes, due to the stone falling back into the pelvis of the kidney or to its passing on into the bladder. *Treatment* consists of bringing the patient under the care of a medical officer, and, in the meantime, putting to bed, giving plenty of water by mouth to increase the flow of urine, putting a hot-water bag on the affected side of the abdomen, and, if necessary, giving morphine, one-fourth grain hypodermically.

Poisoning causing acute abdominal symptoms.—If the poisoning is due to infected foods or foods containing poisonous ptomaines which have been eaten, it is probable that more than one person will apply for treatment. The symptoms are vomiting, diarrhœa (at times bloody), fever, abdominal cramps, and sometimes considerable prostration. In the absence of a medical officer, clear out the intestines with a good dose of castor oil. If a severe case occurs, put the patient to bed, give a purge, and allow nothing by mouth except plenty of water, until symptoms abate, then increase diet gradually. (For other types of poisoning, see chapter on Toxicology.)

In case the acute abdominal symptoms are due to *inflammation of the testicles*, there usually will be a history of urethral infection, or mumps, or injury to the testicle, and on examination the part will be seen to be tender and swollen. *Lead poisoning* may resemble in its symptoms any acute abdominal condition mentioned, particularly acute intestinal obstruction and appendicitis; in this case, however, there is a history of working with lead, paint, or in compartments laden with lead paint chippings; the so-called "blue line" at the margin of the gums most likely will be present, and a blood smear stained with Wright's stain will show stippled red cells and probably anæmia. In case the symptoms are due to a beginning pneumonia, there usually will be a history of chills a short time before, the respiration will be increased with a rising fever, and perhaps a beginning cough with sputum. There is generally a high leucocytosis, even up to 30,000.

The main principles a first-aid man should remember when treating a case with acute abdominal symptoms are: (1) No purgative should be given when appendicitis or intestinal obstruction is suspected; (2) the time elapsing before surgical aid can be obtained is of the greatest importance for the future welfare of the patient; (3) no morphine or opium should be given for pain except in frank cases of gall-stone and kidney-stone colic, as this will mask the symptoms for the surgeon when he arrives.

SOME COMMON EMERGENCY SYMPTOMS.

Fever is a name given to a group of symptoms consisting of a rise of temperature above normal (98.6° F.), with attendant increase in the pulse rate and a rise in the number of respirations per minute; associated with which are generally headache and flushing of the face, a feeling of weakness, irritability, and loss of appetite. Fever is simply a group of symptoms and is not a disease in itself. Fever is one of the main symptoms of all infectious diseases and infections and for some time may be the only evidence of an infection or an infectious disease. It may, however, simply be due to the results of constipation, with absorption of poisonous products from the intestine, but as a rule the temperature in these cases does not go above 101° F.

Handling a fever case.—If possible bring the patient under the care of a medical officer. The problem in a case of fever is to find the cause if possible. Get the history of the case, how long there has been fever, what other symptoms have been or are present; if there has been exposure to an acute infectious disease, or constipation; and examine the throat and skin for evidences of the cause. If no other symptoms are present but an acute fever, which is not very high, and if the patient is not particularly sick, a good purgative probably will give relief. Do not load the patient up with drugs. Constipation with fever is spoken of as *autointoxication*. If the patient has a high fever and is sick, give a brisk purgative, put to bed on a liquid diet, and put an ice bag on the head. In the meantime try to obtain the services of

a medical officer and watch the patient carefully for symptoms which will point the way to ascertaining the cause of his fever. In case the beginning of an infectious disease is suspected the patient, of course, should be isolated.

A cold.—The term "cold" is applied to a group of symptoms consisting of a running at the nose, lachrymation (overflow of tears), fever, generally with headache and malaise (opposite of well-being). These symptoms may be due to a so-called common cold or they may be forerunners of such infectious diseases as influenza, measles, infantile paralysis, or cerebrospinal fever. If the patient is quite sick, fever high, and depression is marked, particularly if there has been exposure to the above-mentioned infectious diseases, suspect that it is something more than a common cold, and, if possible, place under the care of a medical officer. Find out whether the patient has been recently exposed to the above diseases, and by questions and examination ascertain whether further symptoms are present which may lead to a diagnosis. Give the patient a brisk purgative; isolate, and keep on the lookout for further symptoms. If the case is one of common cold, a brisk purgative should be given early, the patient advised to drink plenty of water, and hot drinks given at night, possibly with 10 grains of aspirin, or Dover's powder, to stimulate perspiration.

Headache.—Headache may be due to a great variety of causes. It is a very constant accompaniment of fever, of acute infectious diseases, of autointoxication (see above), and of head injuries. It very frequently is due to eye strain. In all cases of headache it is well always to take the temperature and to inquire into the condition of the patient's bowels. There must be a cause, and the problem is to find it. Do not try to cure headaches with drugs without trying to find out the cause, except perhaps in emergency 10 grains of aspirin may be given after a good purgative. Patients with frequent headaches should always consult a medical officer when available.

Diarrhœa.—Diarrhœa is a term applied to a condition characterized by the passage of frequent, watery stools. It may be due to diseases such as dysentery, meat or other poisoning, typhoid or other fever, or simply to the presence in the intestine of some irritating material from fermentation and putrefaction. Always take the temperature of a person suffering from diarrhœa; question and examine for any other symptoms present or for information able to be given. All cases of severe or continued diarrhœa should be brought under the care of a medical officer. In case the diarrhœa is due to overeating, with consequent absorption of the products of intestinal putrefaction, administer a brisk cathartic to get rid of the offending material.

Hiccough.—Hiccough usually is due to overeating and indigestion. It is caused by spasmodic constriction of the diaphragm, the great muscle which separates the chest from the abdomen. This is the reason that holding the breath as long as possible usually will cure this condition, as the air in the chest forces the diaphragm down so that it does not contract. Drinking a large glass of water in small sips without taking a breath has exactly the same effect. A sudden fright occasionally stops a hiccough, because it causes the patient to take a long breath. If none of these methods are successful, removal of the irritating material from the stomach by vomiting almost always will cure the hiccough. It may, however, be due to some constitutional disease, such as Bright's disease, and persistent cases should be brought under the care of a medical officer.

Convulsions.—Convulsions are most commonly due to epilepsy, hysteria, and various kinds of poisoning. See paragraphs on unconsciousness and chapter on Toxicology. The *treatment* consists in summoning a medical officer, keeping

the patient from biting the tongue or inflicting other injury, and finding out all you can to ascertain the cause.

Earache.—Earache may be due to a diseased molar tooth, to beginning mumps, to a stoppage of the Eustachian tube from an inflammation of the throat, and from inflammation or abscess of the external auditory canal of the ear drum or of the middle ear. In treating, examine the teeth and if there is a molar tooth diseased on the affected side, treat it as described in the section on Dental First Aid. Examine the throat, and if it is inflamed treat it as described below. Examine for beginning mumps by feeling back of the angle of the jaw for tenderness and swelling and put some dilute acetic acid on the back of the tongue to see whether it causes pain and aching in that locality. Pull the ear upward and backward and see if there is swelling and redness in the external auditory canal; if so, the earache is due to inflammation here or in the middle ear. Inflammation of the middle ear is dangerous, owing to the possibility of extension of the process into the mastoid cells, and from there to the brain unless prompt surgical attention is given. If the earache is due to inflammation of the middle ear, get the patient under the care of a surgeon as soon as possible, as the ear drum probably will have to be incised. In the meantime, for inflammation of the external auditory canal or middle ear, put the patient to bed with hot applications or a hot-water bottle on the affected ear.

Chills.—Chills may be simply the result of overexposure to cold and wet, or may be the forerunner of pneumonia, or part of an attack of malarial fever or other disease. Always watch the patient with a chill for other symptoms during and after the chills. The immediate *treatment* consists of putting the patient in bed between hot blankets, using hot water bags, and giving hot drinks.

Sore throat.—Sore throat may be one of the symptoms in quite a large number of diseases, particularly ordinary tonsillitis, diphtheria, scarlet fever, Vincent's angina, and syphilis. Always have these diseases in mind in a case of sore throat, and never fail to examine thoroughly the throat in all cases. If a membrane is present in the throat, the case may be one of ordinary tonsillitis, of diphtheria, or of scarlet fever. If ulcers are present on the throat, syphilis may be the cause. A good *treatment* for an ordinary sore throat is to give a brisk cathartic, have the patient gargle his throat every hour with Dobell's solution or diluted vinegar, and, after gargling, to paint the throat with Lugol's solution of iodine. When possible, always make a smear and stain from the throat of a case of tonsillitis and examine for diphtheria organisms. When in doubt about a case, isolate it and bring it under the care of a medical officer as soon as possible.

REFERENCES.

Modern Surgery.—Da Costa.
Traumatic Surgery.—Moorhead.
Operative Surgery.—Binnie.
The Treatment of Injuries.—Owen.

Bandages and Bandaging.¹

Bandages are employed to hold dressings applied to the surface of the body, to secure splints in the treatment of fractures and dislocations, to create pressure, to immobilize joints, and to correct deformity.

¹ Prepared by Lieut. W. W. Behlow, Medical Corps, United States Navy.

Various materials are employed in making bandages, such as gauze, flannel, crinoline, muslin, linen, rubber, and elastic webbing. Gauze frequently is used because it is light, soft, thin, porous, readily adjusted and easily applied. Flannel, being soft and elastic, may be applied smoothly and evenly, and as it absorbs moisture and maintains bodily heat, is very useful for certain conditions. Crinoline, rather than gauze, is used in making plaster of Paris bandages, as the mesh of the crinoline holds the plaster more satisfactorily than gauze. Muslin is employed in making bandages because it is inexpensive and readily obtainable. It should be soaked in water to cause shrinkage, dried, and finally ironed to remove wrinkles. A large piece of this material easily may be torn into strips of the desired width.

Rubber and elastic webbing are used to afford firm support to a part. The webbing is preferable to the pure rubber bandage, as it permits the evaporation of moisture.

It is of the greatest importance that a hospital corpsman should become familiar with the general rules of bandaging and proficient in the application of the various types of bandages. The comfort of a patient, the security of the dressing, and the professional reputation of the hospital corpsman depend upon the proper application of a bandage. A neatly and properly applied bandage is an indication that the dressing covered by the bandage has been properly performed. An untidy, uncomfortable, insecure, improperly applied bandage reasonably may lead one to suspect that the underlying dressing is of the same character and can result only in adverse criticism.

Various types of bandages, commonly used, are the roller bandage, the triangular bandage, and the many-tailed bandage.

The roller bandage is made from one of the above-mentioned materials, the width and length depending upon the part to be bandaged. For convenience and ease of application, the strip of material is rolled into the form of a cylinder. Each bandage of this type should consist of only one piece, free from wrinkles, seams, selvage, and any imperfections that may cause discomfort to the patient. Although there are various types of mechanical appliances used in winding bandages it is essential that hospital corpsmen should be able to roll a bandage by hand.

The strips of bandage material should be folded at one extremity several times to form a small, firm cylinder. This cylinder is held by its extremities with the index finger and thumb of the left hand. The free end of the bandage is held between the index finger and thumb of the right hand, close to the cylinder. With this hand the bandage then is revolved around the cylinder, which is held in the left hand, the free fingers of which aid in turning the cylindrical roll. The amount of tension exerted upon the free end will determine the firmness of the completed roller. A roller bandage consists of the free end or initial extremity, the body, and the terminal extremity in the center of the cylinder.

The length and width of bandages vary according to the purposes for which they are employed. The sizes most frequently used are: 1 inch wide, 3 yards long, for the hand, fingers, and toes; 2 inches wide, 6 yards long, for head bandages; $2\frac{1}{2}$ inches wide, 7 yards long, for extremities; 3 inches wide, 9 yards long, for thigh, groin and trunk.

GENERAL RULES FOR BANDAGING.

In applying a bandage, the initial extremity is held in the left hand with the external surface of the bandage applied to the part. The roll is held firmly in the right hand, which controls the tension and actual application of the

bandage. It may be necessary, at times, to transfer the roll from the right to the left hand.

Bandages should be applied evenly, firmly, and not too tightly. Excessive pressure may cause interference with the circulation and may lead to disastrous consequences. In bandaging an extremity it is therefore advisable to leave the fingers or toes exposed in order that the circulation of these parts may be readily observed. It is likewise safer to apply a large number of turns of a bandage rather than to depend upon a few too firmly applied turns to secure a splint or dressing.

In applying a wet bandage, or one that may become wet in holding a wet dressing in place, it is necessary to allow for shrinkage. The turns of a bandage should completely cover the skin, as any uncovered areas of skin may become pinched between the turns, with resulting discomfort.

Bandages should be applied in such a manner that skin surfaces are not brought into contact, as perspiration will cause excoriation and maceration of the skin.

In bandaging an extremity it is advisable to include the whole member (arm and hand, leg and foot), excepting the fingers and toes, in order that uniform pressure may be maintained throughout. It is also desirable in bandaging a limb that the part be placed in the position it will occupy when the dressing is finally completed, as variations in flexion or extension of the part will cause changes in the pressure of certain parts of the bandage.

The initial turns of a bandage of an extremity (including spica bandages of the hip and shoulder) always should be applied securely, and, when possible, around the part of the limb that has the smallest circumference. Thus in bandaging the arm or hand the initial turns usually are applied around the wrist, and in bandaging the leg or foot the initial turns are applied immediately above the ankle.

In order to prevent slipping of the initial turns, it is advisable to fold about one-half inch of one edge of the bandage under each turn as it is applied. This improvised hem not only will aid in anchoring the initial extremity of the bandage but also provides a finished, even, neat, cuff-like border. When the size of the part and of the bandage permit, the exposed edge of each turn also should be folded under, as described above, as the finished bandage then presents a neat appearance, and the exposed edge will not become frayed or unraveled. In ascending bandages, the exposed edge will be the lower edge of the bandage, whereas in descending bandages the exposed edge will be the upper edge of the bandage. The final turns of a completed bandage usually are secured in the same manner as are the initial turns, by the employment of two or more circular turns. As both edges of the final circular turn are necessarily exposed, they should be folded under to present a neat, cuff-like appearance. The terminal extremity of the completed bandage is turned under and secured to the final turns by either a safety pin or adhesive tape. When these are not available, the end of the bandage may be split lengthwise for several inches, and the two resulting tails secured around the part by tying.

When the turns of a bandage cross each other, as in the figure-of-eight, the spiral reverse, and the spica, the line of crossings should be straight, and if practicable, should be in the center line of the part bandaged, but the line of crossings should not be over a bony prominence. Likewise the exposed portion of each turn should be of approximately the same width.

In removing a bandage, it may be cut, preferably with bandage scissors. In doing so the operator should be careful to avoid interference with the underlying dressing and the affected area.

If the bandage is removed without cutting, its folds should be gathered up in first one and then the other hand as the bandage is unwound. This procedure will facilitate removal and the rewinding of the bandage, if that be desirable.

APPLICATION OF BANDAGES AND THEIR USES.

Circular bandage.—After anchoring the initial turns of the bandage, as described in a previous paragraph, a series of circular turns is made around the part. Each turn should overlies accurately the turn beneath it, neither ascending nor descending. Uses: Retention of dressing to a limited portion of an extremity, the neck, or the head; compression to control venous hæmorrhage and to promote venous stasis.

Spiral bandage.—After anchoring the initial turns, each turn is applied in a spiral direction in such a manner as to overlies one-third of the preceding turn. (Fig. 72.) As usually applied to an extremity the upper edge of each turn of an ascending spiral is tighter than the lower edge with resulting inequality of pressure. For this reason many surgeons object to its use on an extremity. However, this apparent fault may be overcome to a great extent by applying the bandage in the manner described in a preceding paragraph. Uses: Retention of dressings of the arm, chest, and abdomen.



FIG. 72.—Spiral bandage. (Owen.)

Oblique bandage.—A series of oblique turns are applied around a part in such a manner as to have an uncovered area between turns. The width of the uncovered area should be uniform throughout. Uses: Retention of thick dressings or of temporary dressings which require frequent removal.



FIG. 73.—Figure-of-eight bandage. (Wharton, modified.)

Recurrent bandage.—In applying this bandage, the roller, after securing the primary turns, is carried completely over a part to a point opposite its origin, and then reflected and brought back to the starting point, where it is secured by one or more circular turns.

In the recurrent bandage of the hand, the bandage is secured at the wrist, carried over the back of the hand, around the tips of the fingers, across the palm to the wrist. Held at this point by the disengaged hand of the operator, the bandage is carried across the palm around the tips of the fingers, across the back of the hand to the wrist, where it is held by the thumb of the operator's disengaged hand. Each turn overlies one-third of the preceding turn. The original turn over the fingers may cover the middle and ring fingers, with each succeeding turn applied alternately over the other fingers first to one side and then to the other of the middle finger; or the original turn over the fingers may be applied over the first finger or over the little finger, each subsequent turn covering a portion of the remaining exposed fingers. The reflected portion of the bandage at the wrist is then secured by a number of circular turns. It is customary to complete such a bandage with a figure-of-eight bandage enclosing the entire hand.

Figure-of-eight bandage.—This is undoubtedly the most useful bandage and, with its various modifications, probably is employed more frequently than any other bandage. The hospital corpsman should perfect himself in the application of this bandage, as, with a few exceptions, the majority of bandages are applied on the principle of the figure of eight. Its name is derived from the fact that the turns are applied so as to form a figure 8. Although it is employed commonly in bandages of the joints (elbow, knee, and ankle), it frequently is applied in bandaging the neck and axilla, the head and neck, and the head and jaw (Barton). If properly applied, it may be used very successfully in bandaging the extremities.

Figure-of-eight of hand and wrist.—After anchoring the bandage with two circular turns about the wrist the bandage is carried across the back of the hand to the base of the fingers, then into the palm, across the palm to the back of the hand, and across the back of the hand to the starting point at the wrist, where one circular turn is made. This general course is followed with several similar turns, each one overlying about one third of the preceding turn on the back of the hand. After a sufficient number of turns has been made, the

bandage is terminated with a circular turn around the wrist. Uses: Retention of dressings on the back of the hand or in the palm. (Fig. 73.)

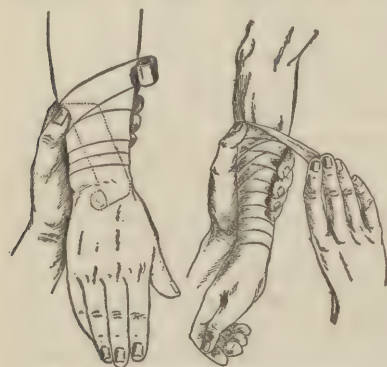


FIG. 74.—Spiral reverse. (Ellison.)

Figure-of-eight of forearm.—This bandage may be the continuation of the figure-of-eight of the wrist and hand, or may be started with primary circular turns of the wrist. The bandage is carried obliquely upward across the back of the forearm and around the arm in its natural course, where it forms the upper loop of the figure-of-eight. The bandage then is carried in an oblique direction downward, across the back of the arm, where it crosses the upward turn of the

bandage. Then it is carried around the lower end of the forearm to complete the lower loop of the figure-of-eight. The same process is repeated several times until the elbow is reached, each turn overlapping the upper one-half or three-quarters of the preceding turn. The bandage is terminated finally with two or more circular turns at the elbow. The final circular turn, with both upper and lower edges of the bandage folded under, should be applied firmly and should present a neat cuff-like appearance at the upper end of the completed bandage.

During the application of this bandage there is always considerable slack in one edge of the bandage where it is carried around the arm. As the bandaging proceeds, however, these loose edges are covered by the ascending turns of the bandage. Uses: Retention of dressings and covering of splints. (Fig. 73.)

The spiral reverse bandage of the arm.—This bandage is in reality a modification of the figure-of-eight, in that only the lower loop or one-half of the figure of eight is completed. After anchoring the primary turns, the bandage is carried obliquely upward on the back of the arm. When this turn reaches the center line of the arm, the thumb of the disengaged (usually the left) hand is placed upon the body of the bandage to hold it securely in place upon the arm. The operator then unrolls about 5 or 6 inches of bandage which is held slack and is folded upon itself by changing the position of the hand holding the

roller from supination to pronation. The bandage then is carried obliquely downward across the arm to a point opposite that from which the ascending turn started. It then is tightened slightly to conform to the part accurately, then is carried around the limb and the procedure is repeated. It is necessary to retain the thumb upon the point of reverse until the succeeding turn reaches that point. As in the figure-of-eight, each turn should overlie at least one-third of the preceding turn, and the reverses should be in a straight line. (Fig. 74.)

Complete bandage of the hand.—After securing the initial turns around the wrist, a recurrent bandage of the hand is applied. The bandage then is carried obliquely across the back of the hand to the tip of the index finger. A circular turn is made around the ends of the fingers. The fingers and hand then are covered by a figure-of-eight or spiral reverse bandage, which finally is completed by two or more circular turns around the wrist. This bandage may or may not be applied to include the thumb. Uses: Retention of dressings of the hand. (Fig. 75.)

Demigauntlet bandage.—Using a 1-inch bandage, secure the initial turns at the wrist and carry the bandage across the back of the hand to the base of



FIG. 75.—Complete bandage of hand. (Wharton.)



FIG. 76.—Demigauntlet bandage of hand. (Wharton.)



FIG. 77.—Gauntlet bandage of hand. (Wharton.)

the thumb, around the thumb, across the back of the hand to the wrist, where a circular turn is made. The same procedure is repeated successively for each finger and the bandage finally terminated with a circular turn around the wrist. (Uses: Retention of dressings on back of hand. (Fig. 76.)

The gauntlet.—The demigauntlet bandage may be extended to include the entire thumb and fingers with either simple spiral turns or spiral reverse turns of each digit. (Fig. 77.)

Figure-of-eight bandage of the elbow.—With the elbow in the desired position, the initial extremity is secured by circular turns around the forearm just below the elbow. The bandage then is carried upward over the flexure of the elbow in an oblique direction and passed around the arm just above the elbow, where a circular turn is made, and then is carried obliquely downward across the flexure and passed around the forearm. This procedure is repeated, with each turn overlying the preceding turn, the turns of the forearm ascending and those of the arm descending until the entire joint is covered. The final one is a circular turn around the elbow joint itself. This bandage may be started with a circular turn around the joint followed by figure-of-eight turns covering the upper part of the forearm and the lower part of the arm. Uses: Retention of dressings around the elbow joint.

Spica bandage of right shoulder (ascending).—After securing the initial extremity by two circular turns around the arm opposite the axillary fold, the bandage is carried diagonally across the arm and front of the chest to the axilla of the opposite side, then around the back of the chest, across the arm and the upward turn to the point of origin. After carrying the bandage around the arm, this procedure is repeated, each turn overlying about two-thirds of the preceding turn until the entire shoulder is covered. The turns should cross in a straight line extending up the center line of the arm over the point of the shoulder. Likewise the turns across the chest and back should overlap each other uniformly, and the turns in the opposite axilla should overlap each other exactly. The bandage



FIG. 78.—Spica of thumb. (Wharton.)

may be secured by either a pin or by adhesive tape. Uses: Retention of dressings of shoulder and axilla, and of shoulder cap. (Fig. 78.)

Bandages of the lower extremity.—The bandages described in the preceding paragraphs may be applied to the corresponding parts of the lower extremity. However, a description of a few of the special bandages of the lower extremity is considered advisable.

Spica bandage of the groin (ascending).—After securing the initial turns around the upper part of the thigh just below the groin, the bandage is carried obliquely upward across the lower abdomen to the iliac crest of the opposite side, transversely across the back and then downward obliquely across the front of the thigh, across the upward turn of the bandage and around the thigh to the point of origin, thus completing a figure-of-eight. This is repeated several times until the entire groin is covered.

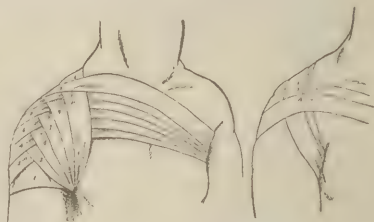


FIG. 79.—Spica of the shoulder. Spica loops of the shoulder. (Eliason.)

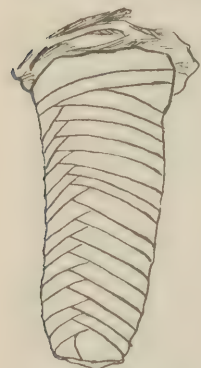


FIG. 80.—Bandage of stump. (Wharton.)

each turn overlying about two-thirds of the preceding turn. The same care in regard to the line of crossings of the turns and to the uniform overlapping of the bandage on the abdomen should be observed, as is noted in the description of the spica bandage of the shoulder. Uses: Retention of dressings in region of the groin. (Fig. 81.)

Spica bandage of the foot.—The initial extremity is secured by two circular turns around the leg just above the ankle. The bandage then is carried across the dorsum of the foot to the base of the toes where a circular turn is made around the foot. After two or three spiral reverse turns are made the bandage is carried across the dorsum of the foot, backward alongside of the heel, around the heel, forward along the other side of the heel across the preceding upward turn on the dorsum of the foot and around the foot to the starting point of the turn. This process is repeated, the turns gradually ascending on both the foot and the heel, the crossings of bandage being in the midline of the dorsum of the foot. The bandage finally is carried upward around the ankle and secured by two or more circular turns at its original starting point. It is possible to apply this bandage without the use of the spiral reverse turns, by employing the figure-of-eight throughout. Uses: Retention of dressings on the foot, and support for sprained ankle. (Fig. 82.)

Bandage of foot, not covering the heel (French).—After securing the initial extremity by two circular turns around the leg just above the ankle the bandage is carried obliquely across the dorsum of the foot to the base of the toes where a circular turn is made around the foot. The bandage is carried up the foot by a few spiral reverse turns crossing in the center line, and then applied as a figure-of-eight around the ankle and instep. The bandage may be terminated just above the ankle or be extended up the leg as far as may be necessary. It



FIG. 81.—Ascending spica. Descending spica. (Eliason.)



FIG. 82.—Spica of the foot (first step). Spica of the foot (completed). (Eliason.)

is frequently practicable to apply this bandage without employing the spiral reverse turns, the figure-of-eight being applied following the circular turns at the base of the toes. Uses: Retention of dressings of foot. This bandage usually is employed in application of bandages covering the entire leg.

Special bandages.

Velpeau bandage.—The fingers of the affected side are placed upon the opposite shoulder, a pad placed in the axilla, and the skin surfaces separated by sheet wadding. Place the initial extremity of the bandage on the shoulder blade of the sound side, carry the bandage across the outer portion of the affected shoulder, downward over the outer and posterior surface of the flexed arm, behind the point of the elbow, obliquely across the back of the forearm and chest to the opposite axilla, and around to the point of origin. After repeating this turn once, the bandage is carried from the point of origin across the back and side of chest, in front of the flexed elbow and transversely across the front of the chest. Then it is carried around the other side of the chest, diagonally across the back to the affected shoulder. The first turn then is repeated, followed by a second circular turn around the chest and flexed arm. Each vertical turn over the shoulder overlaps two-thirds of the preceding turn, ascending from the outer part of the shoulder to the neck and from the upper posterior surface of the arm inward toward the point of the elbow. Each transverse turn also overlies one-third of the preceding turn. These transverse turns are continued until the last turn covers the wrist. The bandage is finally secured with pins, both where it ends and at various points where the turns of the bandage cross each other. (The initial turns of this bandage may be secured by circular turns around the chest under the arm of the affected side.) Uses: Fixation of arm in treatment of fractured clavicle



FIG. 83.—Velpeau (start). (Eliason.)

and fixation of humerus after reduction of dislocated shoulder joint. (Figs. 83, 84, 85.)

Barton bandage.—With the initial extremity of the bandage applied to the head just behind the right mastoid process the bandage is carried under the bony prominence at the back of the head, upward and forward back of the left ear, obliquely across the top of the head, downward in front of the right ear, under the chin, upward in front of left ear, obliquely across the top of the head, crossing the first turn in the midline of the head, thence backward and downward to the point of origin behind the right mastoid. Then it is carried around the back of the head under the left ear, around the front of the chin, under the right ear to the point of origin. This procedure is repeated several times, each turn exactly overlying the preceding turn. The bandage is secured with a pin or strip of adhesive tape, and either a pin or adhesive may be applied at the crossing on top of the head. Uses: Fracture of lower jaw; retention of dressings of chin. (Fig. 86.)



FIG. 84.—Velpeau
(posterior view).
(Eliason.)

Recurrent bandage of head (Mellon bandage).—The initial turns are applied around the head, passing around the nape of the neck, above each ear and around the forehead. When the bandage has reached the center of the forehead on the third turn, its free margin is held by a finger of the left hand and the bandage is reversed and carried over the top of the head in the center line to the nape of the neck. With an assistant holding the bandage at the latter point, it is reflected forward over the top of the head covering the right half of

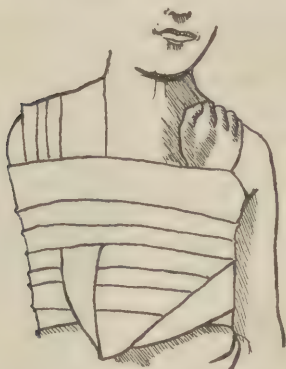


FIG. 85.—Velpeau bandage.
(Wharton.)

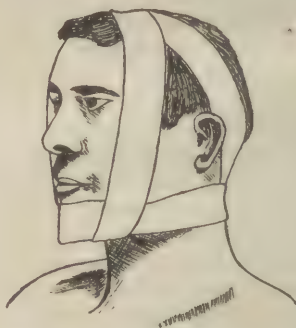


FIG. 86.—Barton bandage.
(Wharton.)

the preceding turn. When it reaches the forehead in the midline it again is reflected over the top of the head, overlying the left half of the first turn. At the nape of the neck in the center line it is again reflected and carried forward overlying the outer half of the second turn. This process is repeated until the entire head is covered, the turns alternating to the right and left of the center line. The bandage finally is completed by several circular turns overlying the original turns and fixing the ends of antero-posterior turns at the nape of the neck and on the forehead, where pins should be applied to provide additional security. Uses: Retention of dressings of wounds of the scalp, of fractures and operative wounds of the skull. (This bandage may be applied with the

turns over the head in a transverse direction extending from ear to ear.) (Fig. 87.)

Crossed bandage of one eye.—The initial extremity is secured by a circular turn around the head below the bony prominence at the back, above both ears and across the forehead. The bandage then is carried from the back of the head, below the ear, obliquely across the outer part of the cheek to the base of the nose at its junction with the forehead, over the opposite side of the head and downward behind the mastoid process. A circular turn then is carried around the head, overlying exactly the original turns. A second turn under the ear and across the face and head then is applied, overlapping the upper two-thirds of the preceding turn. These alternating turns are repeated until the eye (and if more comfortable, the ear on the same side) is completely covered. The bandage is completed with a final circular turn around the head. Uses: Retention of dressing of the eye. (Fig. 87.)

Crossed bandage of both eyes.—The initial turns are applied as above, and the bandage carried forward below the right ear, diagonally upward across the cheek to the base of the nose and over the opposite side of the head above the left ear, and downward behind the left mastoid process. Then a circular turn is applied. When the roller reaches the back of the head below the bony prominence it is carried obliquely forward and slightly upward over the right ear across the forehead and downward over the left eye, the lower margin of the bandage crossing the previous turn at the junction of the nose with the forehead. The bandage then is carried across the left cheek below the left ear and backward to the nape of the neck. Then a circular turn is made, followed by a repetition of the previous turns across the eyes, each circular turn accurately covering its predecessor and each oblique turn overlying the upper one-half of the preceding turn, until both eyes are completely covered. The ears may or may not be included in the bandage, which is completed by two circular turns around the head. Pins are placed at the intersections of the bandage. (Fig. 88.)



FIG. 87.—Recurrent turns. (Eliason.)



FIG. 88.—Crossed bandage (figure-of-eight) of the eye. Crossed bandage of both eyes. (Eliason.)

Sayre dressing.—This consists of two strips of adhesive plaster 3 inches wide and 2 yards long. Two circular turns of a flannel bandage, 4 inches wide, are applied to the arm of the affected side just below the axillary

fold. The end of one adhesive strip is looped around the arm (overlying the flannel bandage) and pinned, with the loop sufficiently large not to constrict the arm. With the arm drawn upward and backward, the strip of plaster is carried across the back and around the opposite side of the chest. It may end here or be carried completely around the chest. The hand of the injured side now is placed as near as possible to the shoulder of the sound side, the skin surfaces being separated by sheet wadding. The end of the second strip is applied over the scapula of the affected side (some surgeons start this strip at the top of the posterior surface of the arm of

the affected side; others apply the initial extremity of this strip on the shoulder of the sound side) and is carried downward on the posterior surface of the arm of the affected side, under the point of the elbow, diagonally across the chest on the posterior surface of the forearm and hand, over the sound shoulder down the back where it joins the first strip of plaster. A small hole is cut in this strip to receive the point of the elbow, which must be protected by a layer of cotton or sheet wadding. Then the entire dressing is covered with a Velpeau bandage. Uses: Treatment of fractures of the clavicle. (Fig. 89.)

"T" bandage.—This bandage consists of a horizontal bandage to which is attached, about its middle, a vertical bandage of approximately one-half the length of the horizontal bandage. The horizontal portion is employed to secure the bandage to the body, the vertical portion being used to retain dressings. This bandage is very useful in retaining dressings about the perineum and anal region. When used for this purpose, the horizontal band is applied around the abdomen above the iliac crests, in such a manner that the vertical portion is placed exactly in the midline of the back directly over the spine. The vertical portion then is brought forward between the thighs and secured to the horizontal portion in front of the abdomen. The vertical portion may be split longitudinally to form two strips of equal width.

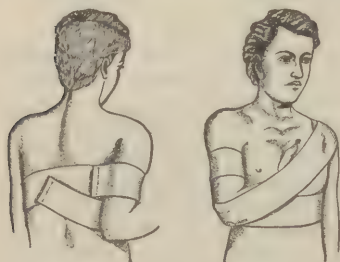


FIG. 89.—Sayre's dressing for fracture of the clavicle, showing application of first and second strips. (Wharton.)

Double "T" bandage.—This differs from the above in having two vertical strips instead of only one. The horizontal portion may be of any desired width. It frequently is used for the retention of dressings of the chest, breast, and abdomen. When so employed the two vertical strips are carried over the shoulders from the back to the front and secured by pins to the horizontal portion.

Many-tailed bandage.—The four-tailed bandage readily is made by splitting a strip of muslin or other material of the desired width, lengthwise, within a few inches of the center of the strip. This provides a bandage with a body and four tails.

The many-tailed bandage is prepared in a similar manner, by splitting the muslin or other material into several strips, having a sufficiently large area in the center for the retention of dressings, etc. The number of tails on each side should be the same.

Plaster of Paris bandage.—These bandages are prepared by impregnating the meshes of crinoline with plaster of Paris of the extra calcined, dental variety. A strip of crinoline about 3 or 4 inches wide, and usually 4 or 5 yards long, is placed on a table. Plaster of Paris then is dusted upon the strip, and evenly rubbed into the meshes of the fabric. A very satisfactory method of preparing this bandage is by constructing a wooden box, 12 inches long, 6 inches wide and 3 inches deep, and at each end, just above the bottom of the box, cutting a slit 5 inches long and one-eighth to one-quarter inch wide. The end of the bandage is drawn into the box through one slit, across the bottom of the box, and out of the box through the other slit. A sufficient quantity of the plaster of Paris to cover the bandage with a layer of powder 1 inch deep is placed in the box. As the bandage is drawn through, plaster of Paris is rubbed into the meshes with the hand or preferably with

a smooth piece of wood approximately 4 inches in length. The bandage may be loosely rolled into a cylinder as it emerges from the box. If the bandages are not to be used within a few hours, they should be wrapped in paper to prevent absorption of moisture.

Application of the plaster-of-Paris bandage.—The part to be encased in plaster of Paris should be covered with a suitable bandage of soft material, preferably flannel. The bony prominences should be well protected with cotton. Care should be taken to remove all creases in the dressing and bandage.

Two rolls of the plaster-of-Paris bandage are placed in warm water. When bubbles cease to arise from the bandage one roll is removed from the water, the excess water being expressed by grasping the roll at its two ends and exerting pressure with the hands. This method prevents the loss of a considerable amount of plaster through the ends of the roll. (*Note.*—As soon as a bandage is removed from the water replace it with another bandage.)

The bandage should be applied rapidly and evenly to the limb. No special form of bandage is necessary, as it is sufficient that the part be properly covered. The second bandage is applied as soon as the first has been completed. During the application of the bandage it should be rubbed with the hands in order to provide a smooth even surface. It also is desirable to rub some loose plaster into the dressing. When the final roller has been applied the surface of the completed dressing should be rubbed evenly with liquid plaster prepared by addition of water to dry plaster until it has the consistency of thick cream.

In many cases, such as compound fractures, it is frequently necessary to provide access to certain areas of the encased limb. After the bandage has partially set a "window" or trap may be cut in the bandage over the desired area.

Removal of a plaster-of-Paris bandage may be accomplished with the aid of a plaster saw. If none is available the plaster may be softened with a small amount of peroxide of hydrogen, hydrochloric acid, or vinegar, and then may be cut with a knife.

Uses: Fixation of fractures; ambulant treatment of fractures; fixation and treatment of injuries and diseases of joints.

Starched bandage.—This bandage may be obtained already prepared or it may be prepared in the following manner: Starch is mixed with cold water until a thin, creamy mixture results. This is heated to form a clear mucilaginous liquid. The part should be covered with a flannel bandage over which a gauze bandage is applied. The starch then is rubbed evenly into the meshes of the material. A second gauze bandage is applied and again treated with the starch mixture. This may be repeated until the desired thickness of the bandage is obtained.

Bandages impregnated with starch may be moistened and applied wet to a part. This type of bandage is occasionally useful in the treatment of sprains of the thumb or fingers.

Triangular bandage.—This bandage is useful in emergencies when the materials for other types of bandages are not available. Although almost any material may be used, unbleached muslin is preferable when it can be obtained. Whatever the material, it should be cut to form a square approximately 3 feet by 3 feet. This square is folded diagonally and cut along the folded border to form two triangular bandages. This bandage may be used either in its triangular form or folded to make a cravat bandage. The former may be employed as a protective covering or as a bandage to retain dressings applied to a part. The cravat bandage is made by placing the apex of the triangle

on the base line and folding the bandage lengthwise to the width desired. In this form this bandage may be used for many purposes.

REFERENCES.

The Treatment of Emergencies.—Owen.

Minor and Operative Surgery, Including Bandaging.—Wharton.

Dental First Aid.¹

Dental first aid consists of the alleviation of pain associated with the teeth and their processes. Pain affecting the teeth is a sign that a diseased condition exists, and while pain temporarily may be relieved, permanent relief can be expected only when the services of a dental officer are obtained.

To understand the principles of dental first aid it is necessary that one should have a knowledge of the structure of the teeth.

STRUCTURE OF THE TEETH.

A tooth is a hard, bony specialized structure of the jaws, the primary function of which is the seizure and mastication of food.

The fundamental parts of the tooth are the crown, neck, root, and pulp cavity. (Fig. 90.) The *crown* is that portion of the tooth above the gums; the *neck*, that constricted portion just below the crown; and the *root*, that part which is embedded in the alveolar process of the jawbone. A longitudinal section of the tooth will show the presence of a central chamber, having the general shape of the tooth, which is called the *pulp cavity*.



FIG. 90.—Vertical section of molar tooth. (Gray.)

The teeth are composed of the following tissues:

Enamel, a calcified tissue covering the crown of the tooth, a hard substance which

forms the protective covering for the softer dentine underneath, and offers resistance to wear and to the chemical action of saliva. Enamel is composed almost entirely of lime salts, its histological structure taking the form of hexagonal prisms or rods which lie at right angles to the plane of the dentine upon which it is supported. These prisms or rods are held together by a very minute layer of cement substance which is not visible to the naked eye. When the teeth are not properly cared for this cement substance is dissolved out and the enamel rods break down, exposing the dentine to the action of the fluids of the mouth.

The *dentine* makes up the bulk of the tooth and gives it its typical form. Among the chief characteristics of the dentine are its density and vitality. Its substance is composed largely of minute canals termed *dentinal tubules*, running at right angles to the pulp chamber, and encasing prolongations of the dentine building cells, or *odontoblasts*, which in turn serve to communicate sensation to the dental pulp.

Cementum covers the outer surface of the roots of the teeth, and closely resembles bone. It receives its name from its action, that of cementing the tooth in the socket, and serves as an attachment for the fibers of the *peridental membrane*, which lines the socket of the tooth.

¹ Prepared by Lieut. Commanders H. E. Harvey and W. L. Darnall, Medical Corps Dental Surgeons, United States Navy.

The dental *pulp* is composed of blood vessels, nerves, and lymphatics. It is extremely sensitive and highly vascular. After developing the dentine, the pulp remains to furnish nutrition and to convey sensations which are necessary for the protection of the tissues.

The teeth appear in two sets, the first, 20 in number, known as the *temporary* or milk teeth, and the second, the *permanent* or succedaneous set, which begins to replace the temporary at the end of the sixth year. The permanent teeth are 32 in number, 16 in each jaw, namely, two central incisors, two lateral incisors, two cuspids (canines), four bicuspid, and six molars, the last ones of which commonly are called the wisdom teeth. (Fig. 91.)

Changes in the structure of the teeth may result from the action of putrefactive agents in particles of food lodged in the spaces between and around the teeth and also from the presence of various bacteria. In addition to causing decay of the teeth, these agents may cause irritation of the gums. The prevention of these changes is considered a part of dental first aid.

Decay of the teeth and irritation of the gums to a large degree can be prevented by attention to and the execution of a few simple principles. "A clean tooth never decays" is a well-known slogan, which, while not true in its entirety, has so much in its favor that it is well worth keeping in mind.

Decay occurs most frequently in places which are not kept clean. The surfaces of the teeth which are seen when the mouth is opened are kept clean and polished, to a great extent, by the cheeks on one side and the food and tongue on the other. The spaces between the teeth, however, are not kept free from debris by the above means or by rough food, which well might serve that purpose. Our attention is, therefore, to be directed toward these spaces. In the usual procedure of brushing the teeth the surfaces which are kept clean by the tongue, food, and cheeks are the only ones which also are scrubbed with the toothbrush. The spaces which are vital in the prevention of decay of the teeth as a rule are not cleansed. To clean these spaces it is necessary to get in between the teeth and remove from these spaces food debris, bacteria, and the products of decomposition. Several methods for the attainment of this result have been advocated, among which the use of dental floss has been the most satisfactory. By its use the individual may remove much of the offending material. A much simpler and more efficient method is that in which a small brush with the bristle tufts not set too closely together is laid against the neck of the teeth, bristle ends toward the tooth, and the bristles gently worked into the spaces between the teeth with a sort of oscillating motion. This is to be repeated several times in each vicinity. To help keep tone in the gums the brush should be passed briskly over all surfaces of mucous membrane in the mouth, including the tongue. Salt on the brush or salt water is a good routine practice, though no objection exists to the use of the most popular dentifrices. Brushing the teeth and gums four times a day, upon arising and after each meal, is given as the ideal, but most of us must be content with a night and morning brush.

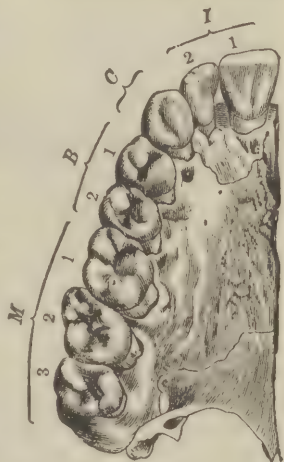


FIG. 91.—Right half of upper jaw (from below), with the corresponding teeth. The letters and numbers point to the classes of teeth and the numbers in classes. (Gray.)

FIRST AID IN DENTISTRY.

Severe pain of dental origin is usually from one of two causes, the first and most frequent being that commonly known as toothache and resulting from an infection and inflammation of the pulp or nerve of the tooth. Decay destroys the enamel of the tooth and exposes the dentine. The dentine is, in turn, disintegrated by decay, which permits bacteria and decayed food products to gain access to the delicate nerve tissue composing the pulp of the tooth. This causes infection, inflammation, congestion, an increase in the amount of blood in the part, and pain, which results when the sensitive nerve tissue is unduly compressed against the hard, unyielding surfaces of the tooth which surround the pulp chamber. In order to relieve this pain either the nerve must be deadened or the excess of blood permitted to escape. The former often is effected by inserting a sedative into the cavity. This soothes the pain by its inhibitory action upon the bacteria and by its anesthetizing effect upon the substance of the nerve tissue. For this purpose oil of cloves, phenol, eugenol, or, better still, a preparation which consists essentially of oil of cloves in which chlore-tone has been dissolved, may be used. Before efficient action or penetration from any medicament is to be expected all decayed food material and softened matter must be gently removed from the cavity. This may be accomplished with any suitable instrument, after which the cavity should be flushed with warm water. The cavity then should be dried with small pledgets of cotton and kept intact from the saliva by means of large pieces of cotton placed in the mouth between the teeth and cheeks. A small piece of cotton moistened with the desired medicament, care being taken to prevent an excess of the solution from coming in contact with the gum and causing discomfort, is placed in the cavity and covered by another piece of cotton which has been dipped in compound tincture of benzoin or Sandarac varnish. The purpose of this procedure is to form a gummy outer covering which comes in contact with the saliva. In many cases it will be found that simple toothache can be relieved in this manner, but in those cases in which relief is not experienced an attempt should be made to puncture the pulp and permit some of the blood to escape. The pain caused by puncturing the pulp is severe and it is advisable to tell the patient that you are about to do this in an endeavor to relieve the pain. If bleeding is effected, relief is obtained within a few minutes after the sedative is reapplied. A sharp instrument is employed for this purpose and is forced quickly through the decayed material in the direction of and into the pulp.

The second common cause of severe dental pain is an abscess. This is the result of the putrefaction of a dental pulp which has died in the tooth, as a result of which gases are formed and pressure is exerted toward the apex of the root. This also forces the decayed material and bacteria into the tissue at the end of the root and sets up an inflammation in the vicinity. This inflammation is outside of the tooth, in the jawbone, and any medicament applied to the tooth or in the cavity will not be likely to have the desired effect. To relieve pain from this cause it is necessary to make some form of an opening so that the gas and other foreign material present may escape. This may be done in two ways. While placing a finger against the tooth to steady it, a sharp instrument is worked into the pulp canal, which, when opened, often permits the gases to escape and brings relief. If, however, the inflammation has progressed to a certain point, it will continue unless drainage is established through the bone. An opening for this purpose easily can be made by the dentist with proper instruments. It is always possible to extract the tooth involved, but this should be done only as a last resort.

Teeth which are acutely abscessed are very tender to the touch and feel to the patient longer than they should be. The duration of the formation of an

abscess varies, but pus formation or suppuration usually occurs within 72 hours and is accompanied by swelling. The swelling indicates that an opening through the bone has been made by the pus working its way toward the surface and the pain usually ceases at this stage. This cessation of pain is due to the fact that the pus no longer is confined between unyielding plates of bone, but is escaping into the soft tissues, at which time the tissues are ready to be opened (incised). The tissues are examined with the finger to determine a point of fluctuation, at which place an incision is made directly toward the bone and in the general direction of the end of the root of the offending tooth. This will permit the pus to evacuate and will relieve the condition for the time being.

Occasionally a patient points to a perfectly sound tooth and complains of it aching. It is, of course, possible that nerve trouble does exist in that tooth, but it is always advisable to look at the other teeth on the same side of the jaw, both above and below, for a cavity, and if one is found, to cleanse it and apply a sedative. This often relieves pain in such cases. Reflected pain is the term given this condition, and so far as the patient is able to judge the pain is present in the tooth to which he points.

The lower third molar teeth often are the cause of pain and swelling during their eruption. Upon looking into the mouth toward the angle of the jaw and just back of the last tooth, occasionally a part of a tooth coming through the gum may be seen, with swelling and redness in the vicinity. In an endeavor to relieve this condition, wrap a small instrument or blunt probe tightly with a wisp of cotton, dip this in tincture of iodine, and insert the probe gently between the tooth and the gum, carefully working it around the crown of the tooth. In some instances this simple treatment will result in the evacuation of some pus and afford temporary relief. The patient should be instructed to take hot salt water, as hot as can be borne, into his mouth and to hold this in the vicinity of the tooth. This procedure should be repeated frequently.

Where a crown or large filling is present in a tooth which is giving trouble, it is usually necessary to make an opening through the filling or crown to obtain access to the dental pulp to which a sedative is applied or the pressure removed.

Gumboils, so called, are small pimples on the gums and are frequently present. This condition is painless, but by no means should they be neglected as it indicates in most cases the presence of a dead nerve in a nearby tooth. This condition should receive professional attention at the first opportunity in order that the health of the individual may not be menaced.

In general, cold will cause an aching tooth to become more painful, while it often will ease the pain in a tooth which is about to suppurate and form an abscess. This test can be applied by retaining ice water in the mouth for a few seconds.

In case it becomes necessary to extract a tooth or the roots of a tooth, an endeavor should be made to work the beaks of the forceps up along the roots until they are well up on them and a firm grip obtained. Then rock the forceps gently from side to side until the roots loosen, when traction should be applied and extraction made. Do not attempt to remove a tooth until it has been loosened in the socket, thus lessening the possibility of breaking off the roots which remain in the jaw and are exceedingly difficult to remove without the use of other instruments.

A condition of sloughing of the gums is seen occasionally wherein the gums assume a very red and inflamed appearance and have a film of dead whitened tissue over their surfaces and between the teeth. The gums bleed when touched and sometimes cause severe pain. In this condition the patient usually complains of discomfort when eating or when brushing the teeth. This condition

is *ulcerative stomatitis*, which may be called *Vincent's angina* (so-called Trench mouth). All cases of ulcerative stomatitis should be considered as contagious and patients having this condition should be warned to separate their mess gear, dishes, drinking cups, pipes, etc., and to boil their eating utensils after use.

The treatment of this condition consists of using a mouth wash of peroxide of hydrogen (full or half strength), which should be retained in the mouth for some time and should be followed by rinsing the mouth with warm water. A one-tenth of 1 per cent solution of chlorazene, full strength Fowler's solution, 7 per cent solution of chromic acid, or a 5 per cent solution of arsphenamine in glycerin then should be applied to all of the inflamed surfaces. Wads of cotton should be inserted between the cheeks and the teeth and between the tongue and the teeth to absorb the excess of this solution, which should be freely applied and permitted to remain on the surfaces of the gums for 10 minutes by the clock. The arsphenamine solution is preferable, but is not available always on smaller vessels. The patient should be cautioned not to swallow any of the solutions used in this treatment. The application of these medicines should be followed by rinsing the mouth and the whole procedure repeated three times daily. The patient should be referred to a dental or medical officer when the services of one become available.

TEMPORARY FILLING MATERIAL.

Attempts to fill teeth by one who has not had training in this procedure usually result in failure. If the filling material does not become dislodged and work out, decay may continue to progress under the filling.

We have at our command however, a temporary filling material, which is valuable where indicated and can be prepared easily and inserted by any one. It consists of a paste of zinc oxide and eugenol, prepared by mixing on a slab with a spatula, adding sufficient powder to make a paste of a consistency less than putty. It can be used in two ways. For a filling which will last a week or so and can be removed without difficulty with small instruments, place over the paste, while on the slab, a piece of clean blotting paper and apply sufficient pressure to absorb all excess liquid. This will leave a mass with puttylike consistency, which should be transferred to the cavity in small pieces, and forced into the cavity with gentle pressure until it is filled completely.

For a filling which will last perhaps several months and stand the stress of mastication the blotter should not be used at first. Instead, a piece of cotton about the size of the cavity should be selected and laid on the mass. The paste should be thoroughly incorporated in the cotton fibers by continued spatulation on the slab. When this is accomplished the blotting paper should be applied to remove excess fluid. The resultant mass can be transferred to the cavity and the edges gently tucked in to make a smooth surface. This filling can be removed only with difficulty. If merely to keep food and debris from a cavity which is sensitive to sweets, heat, or cold but which has not definitely ached, incorporation of cotton is advocated. It can be removed with a sharp instrument by picking away a little of the surface at a time.

Zinc oxide and eugenol paste will not harden in a day outside of the mouth but assumes a dense compact form in a short time after being placed in a cavity. The action of the saliva and body temperature cause it to set. Such a filling has several advantages. No special skill is required in its preparation. No special instruments are needed. It has marked sedative and anodyne effects. It has definite antiseptic properties. If made without cotton it may be readily removed. If made with cotton it will withstand mastication for several months.

REFERENCES.

Operative Dentistry (2 vols.).—Black.

CHAPTER IV.

NURSING.¹

The qualifications necessary for a good hospital corpsman may be classified under three headings, physical, mental, and moral. Physical qualifications require health, strength, and endurance, and these can be maintained only by the faithful practice of habits of personal cleanliness, strict obedience to the laws of hygiene, avoidance of causes of indigestion, the securing of a sufficient amount of fresh air, sleep, exercise and recreation, and prompt attention to all minor ailments. To be mentally qualified requires education, judgment, the faculty of observation, a sense of order, and a good memory.

Higher education, although desirable, is not absolutely essential for the success of a hospital corpsman, but he must have a high order of intelligence and a real desire to learn. With these assets it soon will be realized how important it is to know the underlying principles that govern the work in which he is engaged. Observation is the faculty of taking notice of things and requires constant practice for its development. A hospital corpsman must be quick to observe minute details and equally quick to act intelligently in accordance with his observations. Loss of valuable time and many reproofs may be avoided by quick observation. A hospital corpsman possessing this quality when assisting at a treatment or an operation, will notice what is required and anticipate the doctor's needs.

Judgment is the faculty of being able to reach a correct decision; that is, knowing what is best to do or say under known conditions. A hospital corpsman's observation and judgment should be such that when two conditions are placed before him he will weigh them quickly in his mind and decide as to the relative value of each.

The sense of order must be cultivated both in mind and habits, and literally means, "a place for everything and everything in its place." A hospital corpsman should not tolerate disorder in the things about him nor should he allow confusion in his work. He must strive to make his work better than another's work. Particular care in folding gauze for dressings, folding linen, and arranging supplies helps to cultivate the habit of exactness.

Memory is very important in nursing. It requires constant practice of concentrating one's attention on the thing at hand, and of forming mental associations which will assist in recalling the things to be remembered.

Moral qualifications required by hospital corpsmen include truthfulness, obedience, dignity, tact, courtesy, sympathy, and economy.

Truthfulness in the care of the sick takes on a broader meaning and embraces honesty of purpose, frank acknowledgment of an error, prompt confession of anything left undone, absolute accuracy of statements, and the conscientious performance of minute details.

¹ Prepared by S. V. Kiel, A. Chew, and V. M. Visel, members of the Nurse Corps, United States Navy.

Obedience does not mean merely obeying rules and regulations, but includes prompt, unquestioning, and intelligent obedience to authority, regardless of whether the person in authority is an officer or a fellow hospital corpsman.

Dignity, if genuine, admits of no rudeness or familiarity from others, and at the same time is free of any display of personal importance or superiority.

Tact is the ability to deal with others without giving offense; in other words, it is doing or saying the right thing at the right time.

Courtesy is defined as a well-bred consideration for others founded upon kindness, and is a very necessary qualification when the sick are irritable, fault-finding, or unjust in criticism. It must be remembered always that a sick person is like a child and often is not responsible for his speech and actions.

Sympathy is the feeling corresponding to that which the other person feels, and may be expressed by a smile or an encouraging word, but must not interfere with the carrying out of orders, treatments, or dressings. Patients are benefited by receiving proper care and treatment, although the reason for such may not be evident at the time to either the hospital corpsman or to the patient.

Economy in all things is very essential. Extravagant habits are easily acquired where there are large quantities of supplies, and must be especially guarded against.

Professional ethics may be defined as the moral obligation which a hospital corpsman owes to the service, its officers, the hospital, the ship, the station, or the training school, and to his fellow hospital corpsmen. He should always so conduct himself that he will do his part to be a credit to and add to the good reputation of the service, of the Medical Department, and of the unit to which he is attached.

MANAGEMENT AND GENERAL SUPERVISION OF WARDS.

Hospital wards are under the general supervision of the executive officer, and each ward is under the direct supervision of a ward officer. The chief nurse has general charge of medical and surgical wards, and in each ward a nurse has direct charge of that ward. Hospital corpsmen are detailed for ward duty and are under the direction of the nurse, who is responsible for the care and nursing of the patients and for the management of the ward. In the absence of a nurse the senior hospital corpsman assumes charge of the ward.

The venereal wards are in charge of senior members of the Hospital Corps, with others detailed to assist. Under the direction of the medical officer, they administer medicines and give treatments, including venereal prophylaxis, do the dressings, and are responsible for the care and nursing of the patients and the order and cleanliness of the wards.

On board all fighting ships the hospital corpsmen perform all the duties of their own and of the Nurse Corps.

Admission of a patient.—When a new patient is admitted into a ward it is necessary to obtain a record of his name, rate, the ship or station from which he was received, the name and address of his nearest relative or friend, the date and place of his birth, and any other information required for the admission card. This card is made out in duplicate, one copy for the ward files and the other for the ward officer's office, whence it finally goes to the record office. A bedside card or tag is made out showing the patient's name, rate, age, diagnosis, and religion. This is placed in the card rack attached to the bed, or, in the absence of a card rack, is tied to the foot of the bed.

The patient's temperature, pulse, and respiration are taken and recorded. He then is given a bath—either a shower, tub, or sponge bath in bed, as the case may permit—is dressed in a clean suit of pajamas, and retained in bed until seen by the ward officer. During the bath the patient should be inspected carefully for skin eruptions, ulcers, tumors, swellings, gonorrhœa, vermin, and other evidences of venereal or contagious diseases, and for the presence of any other abnormalities. The results of this inspection should be reported to the person in charge of the ward. The patient's money and valuables should be listed, put into an envelope marked with his name, rate, and the date, and turned over to the executive officer for safe-keeping. Receipts for such deposits are given by the executive officer. In the temporary absence of the executive officer the officer of the day is his representative. The patient's toilet articles, papers, books, and any personal effects which may be required in the ward are placed in his bedside locker. All other effects, properly tagged, are sent to the bag room.

Daily routine duties in a ward.—Bed patients should have their hands and faces washed and teeth cleaned by the hospital corpsman on night duty in the ward. All patients should have their hair combed and all temperatures should be taken before the day staff comes on duty. The day staff serves all breakfasts and clears away the dishes. The ward hospital corpsman is responsible for the patients under his charge, and should see that they are given their proper diets. If the food on any tray remains untouched, he should determine the reason; it may be that the patient needed assistance in order to eat, or that he had lost his appetite, or for some other reason did not desire food. Whatever the cause, a report should be made to the medical officer.

Beds should be made up and the ward aired, swept, and dusted, and then put in readiness for sick call at 9 o'clock. All ward work should be discontinued during sick call. There should be absolute silence during sick call and all convalescent patients who are able should stand at attention at their bedsides.

When making sick call with the ward medical officer, towels, tongue depressors, flash light, and stethoscope should be carried for the use of the doctor. All orders should be written in the order book and signed by the ward officer before leaving. The drug book, diet sheet, requisition slips, and liberty lists should be in readiness for the ward officer's signature.

After sick call, the order "carry on" may be given, uncompleted work in the ward finished, treatments and medicines administered, dressings done, slips taken to their respective offices and the ward made ready for the executive officer's inspection. All supplies for the day should be obtained between the hours of 10 and 12 and drug baskets taken from the dispensary before noon. Attention should be given to medicines, temperatures, and diets between 11 o'clock and noon. After dinner the patients should be allowed to rest and the hospital corpsmen should police the wards. The necessary work of the ward must, however, be carried on. A hospital corpsman under no circumstances should leave his ward without permission or proper relief. On visiting days he should see that visitors do not sit or recline on the beds, provide chairs for visitors, and when visiting hour is over, see that they leave the ward. If visitors have not heard the word passed that visiting hours have ended, the hospital corpsman should tactfully inform them that it is time for them to go. The evening meals then are served, and not sooner than one hour afterwards, baths should be given (all patients should have baths at least every other day). Evening sick call is held sometime after 7 o'clock, and should be followed by the evening treatments, medicines, and dressings. All patients are mustered, any absentees reported to the officer of the day.

and all ward lights, except night lights, put out at taps. The wards, heads, bath rooms, diet kitchen and offices should be left in a clean condition by the day hospital corpsmen. There should be sufficient ice in the refrigerator for the night as well as enough supplies, such as milk, fruit, eggs, and broth, for the fluid diets, and eggs for the morning breakfasts.

Care and cleaning of a ward.—The essential conditions which should be maintained in a ward or sick bay are: Proper ventilation, freedom from unpleasant odors, uniform temperature (the degree required depending upon the diseases in the ward), cleanliness, definite places for furniture and utensils, and furniture and furnishings kept free from stains and defacement.

In order to have proper ventilation in a ward the incoming air must be pure, the air in the ward kept in circulation without causing a draft. Exposure of patients should be avoided by having them sufficiently covered when the windows are opened to air the ward.

The necessary precautions to prevent odors in wards are : Bed-pans should be covered when carrying them through the ward, and should be clean when not in use; bed covers may be kept free from fecal odor when giving an enema by using a blanket which can be aired; patients and bedding should be absolutely clean; dressing and garbage pails should be kept covered, emptied frequently and kept clean; hoppers and toilets should be properly flushed and a deodorant used frequently; and waste pipes, sinks, and hoppers should be free from obstruction.

A low temperature, providing the patient's body is kept warm, often will act as a respiratory and circulatory stimulant. Patients who are restless and excited frequently become quiet and go to sleep out of doors or in a cold room, while, on the contrary, patients become restless and do not sleep well in a hot ward. Patients with chronic diseases, associated with poor circulation and anemia, usually require warmer surroundings than fever patients, while those in shock and under the influence of an anæsthetic temporarily require a still warmer environment. The average ward temperature should be 68° F., during the day and 65° F., at night.

The cleanliness of a ward is of great importance, as dust and dirt favor the development of bacteria. The wards, including beds, lockers, chairs, desks, windows, radiators, electric light fixtures, doors, woodwork and paintwork, should be dusted daily.

The materials usually used in cleaning are: Brooms, mops, dustpans, cloth dusters, warm water, soap powder where fresh water is used, salt-water soap where salt water is used, sand soap, and metal polish. Hot water should be used to remove dirt and cold water to remove blood stains. The addition of a small amount of sodium carbonate (washing soda) or ammonia will soften the water. If lye is used great care must be taken to dissolve it first in water, and to open the can over a hopper or on a cement or stone deck, to prevent the powder from destroying and staining woodwork, paint, varnish, etc.

Ink stains may be removed from linen by the application of lemon juice and salt, afterwards putting the material in the sunlight to dry and then washing with warm water and soap. If the stain has not disappeared the process should be repeated. To remove *iodine stains*, wash the spot with alcohol or boiling water. *Permanganate of potash stain* may be removed by washing it in a solution of oxalic acid, followed by ammonia water, and then rinsing in clear water. *Silver nitrate stain* may be removed by covering the spot with tincture of iodine and after a few minutes washing with alcohol, ammonia water, and clear hot water. *Vaseline stains* may be removed with kerosene and hot water and soap. *Rust stains* on iron and steel may be removed with kerosene, but

care must be taken not to apply kerosene to a stove at such time that it will not have evaporated before the stove is used. This precaution is necessary because of the inflammable nature of kerosene. If alcohol is spilled on a white enamel surface, oil should be applied to the spot before attempting to remove the alcohol. This is necessary because the enamel is soluble and may be removed by the alcohol. *Rust and other stains* may be removed from granite and enamel ware by washing with kerosene, hot water, and soap. All utensils should be dried thoroughly before they are put away, in order that rusting may be prevented. *Rust stains* on fabrics may be removed by washing in warm oxalic acid or citric acid solution (if the colors will bear it) and rinsing in water. Do not apply hydrogen peroxide to any fabric for the removal of stains, as it tends to destroy the fibers of the fabric.

The walls of a ward should be swept down once a week with a long-handled broom and, if possible, washed once a month.

The cleaning of floors depends upon the material of which they are made. They should be swept as often as necessary, at least three times a day, and care taken that no dust is raised in the ward during the sweeping. Stone and unpolished wooden floors should be scrubbed occasionally with a scrubbing brush, hot water, and soap powder. The water should be changed frequently. Dirty water will not clean anything. After washing, floors should be thoroughly dried and hardwood floors should be waxed and polished once each week.

Everything in a ward should be dusted daily. In dusting, a damp (not wet) duster should be used, a basin of clean water should be at hand in which to rinse the duster frequently. It is impossible to clean anything with dirty water or a dirty duster. The habit of removing dust with a firm stroke should be formed, as it is a waste of time and energy to move the duster back and forth on a surface. Dust should be removed from cracks and crevices (those too small for the duster to enter may be cleaned with the point of a wooden toothpick), and when dusting beds, the bars which are not exposed should not be forgotten. When cleaning the medicine cabinet, remove only a few bottles at a time (if called away they will not have to be left out of place). If dusting is done daily and systematically, everything will be ready for the commanding officer's inspection without any extra effort. Dusters always should be washed after use and not put away unclean. Polished furniture should be dusted with a dry duster or one that has been slightly oiled.

Copper, brass, and nickel should be cleaned frequently with the regulation metal polish. Alcohol and ammonia should be used sparingly, as they deteriorate the polish. Sand soap should not be used for glass or metal, as it may scratch the surface. Porcelain tubs and sinks are cleaned best with hot water and the special cleansing materials provided for that purpose. Acid destroys the polish on marble, therefore an alkali should be used to neutralize and remove the acid. If orange or lemon juice is spilled, ammonia and soda applied immediately will prevent a stain.

Refrigerators should be washed out daily with hot water and soap and the drains should be cleaned and pans emptied at least three times a day.

Utensils such as bedpans, urinals, and irrigating cans should be scrubbed daily with hot water, brush, and soap, and kept clean at all times. Rubber sheets and rubber utensils are cleaned best with warm (not hot) water and soap, then rinsed in a disinfectant solution and hung up to dry. Under no conditions should they be folded and put away until thoroughly dried. Heat, acids, and fats destroy rubber.

Beds should be dusted daily with a damp duster, and on the discharge or death of a patient the springs should be whisked with a disinfectant solution and the bedstead washed with hot water and soap.

GENERAL NURSING PROCEDURES.

Temperature, pulse, and respiration.—The chief source of heat production in the body is the oxidation of material derived from the food which takes place in tissues, especially in the muscles and the secretory glands. Heat also is derived from friction within the body caused by movements of the muscles, by the circulation of the blood and other internal activities, by the ingestion of hot foods and drinks, and by radiation from the sun, fires, and appliances which generate external heat. Although heat is being generated constantly within the body, the body temperature of a healthy person remains at approximately 98.6° F. This is brought about by the fact that there is an equally constant loss of heat effected in the following ways: By radiation and conduction from external surfaces of the body, by constant evaporation of water from the skin, by taking into the lungs colder air which requires heating before being exhaled, and by the ingestion of cold food or drink.

Heat production and heat elimination are adjusted by the vasomotor nerves. When the outer air becomes cooler the superficial blood vessels, by action of



FIG. 92.—Clinical thermometer.

the vasomotor nerves, contract, and consequently there is less blood at the surface to become chilled and more in the interior of the body to further oxidation. Individuals adopt certain voluntary means of regulating body heat; for example, when cold, they put on more clothing, eat and drink more hot food and liquids, and take more vigorous exercise, and when they are too warm they do the reverse.

The degree of heat of the body is measured with a clinical thermometer. In a healthy adult the normal temperature should be 98.6° F., but this is subject to daily fluctuations of a fraction of a degree. Normally the temperature rises gradually from 7 a. m. until the corresponding time in the evening, when it gradually falls; usually reaching its maximum between 5 and 8 p. m., and its minimum between 2 and 6 a. m. In children the average temperature is higher and in old people lower.

Excessive exercise, excitement, constipation, or indigestion may cause a slight rise in temperature in a healthy person. Marked rises in temperature are due to bacterial activity in the body and to failure of the mechanism which controls the elimination of excess heat, and marked falls in temperature to vomiting, diarrhœa, lowered vitality, hæmorrhage, shock, and any depression of the nervous system.

The following table indicates the deviations in temperature and the significance:

	°F.	°C.		°F.	°C.
High fever.....	103-106	39-41	Normal.....	98-99	36.5-37
Moderate fever.....	101-103	38-39	Subnormal.....	97-96	36-35.5
Subfebrile.....	99-101	37-38	Collapse.....	96-95	35.5-35

The temperature of the body is taken with a clinical thermometer, by mouth, axilla, rectum, or groin. (Fig. 92.) In taking temperature by mouth,

the hospital corpsman should make certain that the patient recently has not had any hot or cold substances in his mouth. After carefully removing any of the disinfecting solution on the thermometer the mercury bulb should be placed under the tongue, and the patient instructed to keep his lips closed during the time the temperature is being taken. The temperature should not be taken by mouth when the patient is coughing, has dyspnoea, is unconscious, delirious, insane, or too young to understand what to do. Do not leave the thermometer in the mouth longer than the time required for it to register (one to three minutes usually).

When taking temperature by axilla, wipe the surface thoroughly dry, place the bulb in the hollow of the armpit with the stem pointing toward the chest and see that the patient holds his arm pressed closely to his side for at least five minutes. Temperature taken by axilla or groin is 0.5° lower than by mouth.

In taking the temperature by rectum, the bulb should be well lubricated with vaseline before inserting and the rectum should be free from faecal matter. The thermometer is inserted gently for about 1 inch, pointing it slowly backward. It is allowed to remain for at least five minutes. Never allow a patient to insert the thermometer. Rectal thermometers and their containers should be properly marked, "for rectal temperatures." The rectal temperature is 1° higher than that recorded by the mouth.

Clinical thermometers and their care.—A clinical thermometer is a self-registering instrument which is used to ascertain the body heat. It contains a glass bulb filled with mercury and a stem on which there is a graduated scale. Mercury is expanded by heat, and when the bulb is placed in contact with a warm body the mercury expands and forces the column up the graduated scale; the height which the column reaches depends upon the degree of temperature. Clinical thermometers are self-registering—that is, the mercury remains at the height to which it has ascended until shaken down. Therefore, it is always necessary to see that the thermometer is shaken down to about 95° before using. The mercury is shaken down by firmly holding the upper half of the thermometer between the first and second fingers and thumb, flexing the hand and giving a quick sharp jerk, repeating until the mercury registers 95° . It is not advisable to force the mercury below 95° , because there is a slight constriction in the stem, which, if the mercury goes below this point, may prevent proper expansion of the mercury column. If this happens, it can be brought up again by carefully placing the thermometer in warm water at not over 100° F. A thermometer should be shaken down over a bed to lessen the possibility of breaking if it slips from the hand.

Thermometers should be cleaned before and after use. When in constant use they should be kept in a disinfecting solution with a soft pad of cotton at the bottom of the container. The container should be kept filled with the solution and changed daily. Thermometers used for rectal temperatures should be kept in separate containers and marked plainly. When thermometers are not marked to indicate how long they require to register, they should be considered to be three-minute instruments. The average thermometer requires three minutes to register properly. Should a thermometer apparently fail to register accurately a patient's temperature, the latter should be taken a second time with another thermometer.

Pulse.

The momentary distention of the arteries caused by the blood being forced into them at each contraction of the left ventricle of the heart is called the pulse, and wherever a large artery approaches the surface of the body this

pulsation may be felt and counted. The common locations for taking and recording pulse are the radial arteries at the wrists on the thumb side; the facial arteries where they pass over the lower jaw bone, just forward of the angle of the jaw; the temporal arteries, slightly above and in front of the ears; the femoral arteries at the inner surface of the upper part of the thighs; and the dorsalis pedis arteries on the dorsal surfaces of the feet.

The principal points to notice when counting a pulse are its frequency, volume, tension, regularity, and any peculiarities in the pulse or the condition of the artery.

Frequency of pulse rate is the number of pulsations occurring per minute, and it is this number which is recorded. A good way to estimate the pulse rate is to count the number of pulsations for 30 seconds, the number for a second 30 seconds, and if the numbers are the same, multiply by 2. If not, count for one or more additional 30-second periods. In counting or taking a pulse, the middle and index fingers are placed over the artery and the artery lightly compressed against the bone. Never use the thumb, because there is a superficial artery in the thumb which might register your own instead of the patient's pulse. Do not make too strong pressure, for if the pulsations are feeble, the pressure may obliterate them. This is a very common fault with beginners. When taking the pulse at the wrist, the patient's arm should rest upon something, and before and after counting, the fingers should be held over the artery long enough to note characteristics other than the frequency of the pulse.

A *normal pulse* in an adult should feel firm and elastic, and should be regular both in rate (72-78 pulsations per minute) and in rhythm. There are various types of irregularity both in rate and in rhythm which, if recognized, should be recorded when the pulse is taken.

The *volume* of the pulse refers to its size and depends upon the force of the systolic contraction of the heart and upon the general physical condition of the body. Some of the conditions affecting the volume of the pulse are disease, exercise, excitement and emotion, the action of drugs, fatigue, and sleep. When the volume of blood flowing through the arteries is great the pulse is said to be *full*, and if at the same time the frequency of the beat is increased it is said to be *full and bounding*. Other descriptive terms used in connection with the volume of the pulse are *thready*, when the pulse feels like a little thread; *hard*, when the pulse is very small in volume but feels hard; and *small*, when the volume is lower than usual.

Tension is the resistance of the walls of the arteries to the pressure of the blood stream and the force of the blood pressure is estimated by the degree of tension. If an artery remains distended between beats, its tension is said to be *high*; but if it does not remain distended between beats, is easily compressed and feels empty, the tension is spoken of as *low*. Drugs and disease as well as other conditions, such as hæmorrhage and changes in the elasticity of the arteries, may alter the tension of the pulse. To determine the tension of the pulse, the pressure required to obliterate the pulse beat is noted. Accurate measurements can be obtained only by use of the sphygmomanometer (blood-pressure apparatus), but an approximate idea of the tension may be obtained by increasing the pressure of the finger nearest the heart until the other finger fails to feel the pulse beat.

The *regularity* in rate and rhythm of the pulse varies as a result of the action of drugs, disease, and in accordance with the physical and mental condition of the patient. Usually the pulse rate rises at the rate of about 10 beats for every 1 degree of increase in temperature, though in some diseases

the pulse beat may be high or low in proportion to the degree of temperature. A pulse is said to be *regular* when each successive beat is equal in volume, tension, and frequency.

There are several variations occurring in the rhythm of the pulse and the most common of these irregularities is known as *intermittent* pulse. Although the heart may not miss a beat, because of failure of the arteries to distend properly the pulse skips a beat. This intermission may occur at regular or irregular intervals, and while it may be due to a weakened heart or some condition of the arteries it frequently occurs in apparently healthy persons who are addicted to the overuse of alcohol, coffee, tea, or tobacco. However, when a pulse is irregular in rate, in rhythm, or in both, this irregularity generally is a symptom of serious disease, commonly of the heart. Beats may follow each other with great rapidity and then change to slow with perhaps an intermission, and at the same time a variation in force and volume may be present.

A *dicrotic* pulse (from a Greek word meaning double beat) is one which frequently occurs in typhoid fever and other diseases causing a depleted condition of the system. It is due to lack of tone of the arterial walls. The pulse is said to be dicrotic when the beats seem divided, the second part of the beat being weaker than the first part. In this condition the two beats must be counted as one, in recording the pulse rate.

When taking the pulse the condition of the artery should be noted by gentle and careful digital examination while apparently taking the pulse. A normal artery feels round and elastic, and usually is firm. But if it feels twisted, or hard and unyielding, and gives one an impression that it is brittle, this information should be reported to the medical officer and recorded, as such conditions often are important symptoms of disease.

It is sometimes necessary to take the pulse in each wrist because of difficulty in obtaining an accurate count in one; and in certain conditions not often found, the pulse in one wrist is not the same as that in the other.

Respiration.

Respiration is the alternate expansion and contraction of the chest walls causing the lungs to expand and contract. The expansion movement, by means of which air is drawn into the lungs, is known as *inspiration* and the contraction movement, which forces the air out of the lungs, is known as *expiration*. Respiration consists of one inspiration and its accompanying expiration and a period of rest between them. The normal number of respirations of a healthy adult is 18 to 24 per minute. The respiratory movements are more or less under the patient's control and therefore should be counted without his knowledge. To do this, keep the fingers upon the pulse as though still counting it, at the same time watching the rise and fall of the patient's chest, thus counting the respiration for a full minute. In recording the respiratory movements, notation should be made as to whether or not they are shallow or deep, regular or irregular, and whether or not the chest walls expand normally. Any difficulty in breathing, or labored breathing which usually is accompanied by rapid respirations should be noted. This condition may be caused by heart disease or by conditions of the lungs. *Cheyne-Stokes respiration* begins quietly, each succeeding respiration being louder and deeper until a climax is reached, which is followed by a complete pause before inspiration is again resumed.

Clinical charts and clinical notes.

A *clinical chart* should be prepared and kept up to date for each person admitted to the ward. (Fig. 93.) The clinical chart (N. M. S. Form "Q")

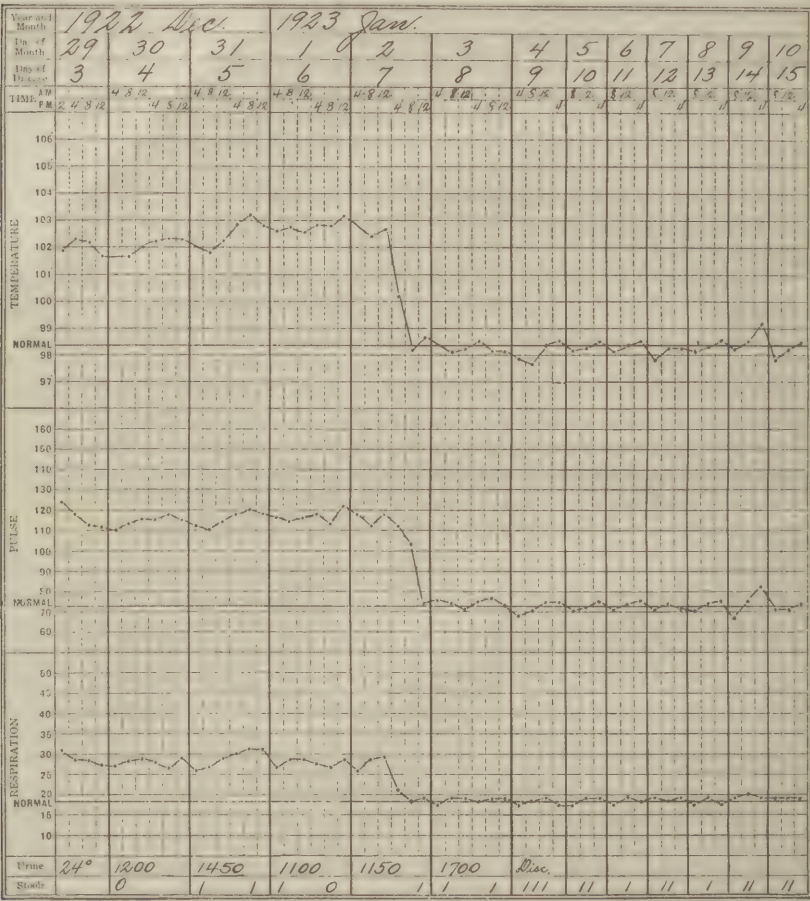
shows the name of the patient, the rate, rank (in the case of officers), the diagnosis, age, and race. The year, month, day of the month, and the day of the disease usually are recorded by figures; the time of taking the temperature, pulse, and respiration is recorded in either the "a. m." or "p. m." spaces, and the frequency and amounts of urine and stools indicated in the spaces so

N. M. S. Q.

CLINICAL CHART

Page No. 1

Name *Doe, John (None)* Rate *Sea 20.*
Diagnosis *Pneumonia, lobar* Race *White* Age *21*



Day after Operation may be entered in red in the space for Day of Disease.
Draw heavy lines to separate calendar days.

4-5424

FIG. 93.—Typical clinical chart.

designated for that purpose. The word "mouth," "rectal," "axilla," or "groin" placed in red ink in the space marked "temperature" indicates to the medical officer the manner in which the temperature is taken. The dots indicating the temperature should be made in such a manner that they may be seen distinctly. These dots should not be too large, and should be in the center between the dotted vertical lines, the distance between the horizontal straight lines depending upon the fraction of the degree of temperature. The

lines joining the dots should be straight, not curved, and at the end of the day a red line should be drawn vertically from the top to the bottom of the chart to indicate the day of the disease. The hospital day begins at midnight and ends the following midnight.

An additional sheet, called clinical notes (N. M. S. H. Form 17) should accompany the clinical chart and indicate all treatments and medications with statements regarding the results. For example, after the administration of a narcotic, a note should be made stating the effect obtained; in like manner a notation of the effects of stimulants should be recorded in the remarks column of the chart. The diet should be noted and also any abnormality which may arise, and if it is impossible to administer any treatment or food which has been ordered, this especially should be recorded.

Charts and records are used to enable the doctor to know the condition of the patient during his absence, to provide a means of comparing the patient's condition from day to day, to indicate the effect of medicines and treatments ordered, and to provide a record that may be preserved indefinitely for use in compiling statistics and for similar purposes or investigations. All records should be neat, free from erasures, the printing or writing should be legible, the lettering small but readable, and the statements accurate, brief, clear, and to the point. All medication and treatments should be recorded, together with the time administered, and the results obtained. Any unusual occurrence, such as hæmorrhage, vomiting, etc., should be recorded in detail. When it is necessary to keep a record of the amount of urine voided, it generally is required that a record of the amount of fluids taken for the day be also kept.

Administration of medicines.

Before a hospital corpsman should be allowed to administer medicines he should know the physiological action of the medicines in common use (this enables him to observe the effects of the medicines), the minimum and maximum doses of drugs, especially poisonous ones (such knowledge will prevent mistakes), and the treatment of poisoning by the various classes of poisons. He should be familiar with the signs of overdosing, and should watch for any unusual symptoms after administration (some people have an idiosyncrasy for certain drugs and some drugs are not excreted readily, thus accumulating in the system and producing a poisoning effect). A hospital corpsman should appreciate and understand that it is easy for certain people to contract the drug habit, and any unusual facts regarding the patient's apparent desire for drugs should be reported to the medical officer.

A hospital corpsman should be familiar with all the abbreviations and symbols used in writing prescriptions in order that he may understand the orders. (See chapter on Pharmacy.)

The methods of administering medicines are taken up in the chapter on *Materia Medica*. A medicine list should be kept in the ward and should contain the patient's name, the medicine prescribed, the dosage, and the manner in which it is to be given. This enables a relief-hospital corpsman to dispense the medications without referring to the order book.

The following important points should be remembered in the care of, the measuring of, and the administration of medicines. The poison locker should be locked at all times when access to its contents is not required and the key retained by either the ward nurse or an experienced hospital corpsman, preferably one of the higher ratings. On inspection morning the poison locker should not be opened until the commanding officer indicates his wish to inspect it, and then should be locked immediately in his presence. All medicine bottles and labels should be clean and arranged in an orderly manner.

All medicines should be kept in a cool place and unlabeled medicinal preparations should not be allowed in the ward (in case of doubt throw the medicine away—never guess). Medicines should be administered in the proper manner, at the proper time, to the proper person, and in the correct amount; those to be given before or after eating one-half hour before or after the meal. Graduates and pipettes should be used in measuring drugs; minims should be measured as minims and drops as drops when so ordered. There is a marked difference in the amounts of certain drugs when measured as minims and as drops. Accuracy in measurements is of paramount importance. In pouring medicines the glass or container should be held on a level with the eye; if the mark is above, too little may be dispensed, and if below, too much. The label on the bottle should be read at least three times—at the time of taking the bottle off the shelf, before removing the desired amount, and after the medicine has been removed. This procedure is a triple check to insure the use of the correct medicine. All bottles containing a sediment or preparations which are not clear should be thoroughly shaken before use. To avoid staining the label when pouring a medicine the bottle should be held in such a manner that the label will be on the upper side, and before replacing it the rim of the bottle or container should be wiped with a piece of gauze. It is a good plan to recork bottles immediately after removing any of the contents, as many medicines contain or are dissolved in volatile substances and will become stronger or weaker if allowed to remain uncorked. Medicines which change color or form a precipitate when combined (indicating the probability that a chemical change has taken place) should not be administered until after the medical officer's attention has been invited to this fact.

It is advisable to withhold certain foods prior to and during the administration of certain medicines, as milk and eggs when calomel is given (the protein combines with the mercury to form an albuminate which will not produce the desired result and may be injurious to the patient). Syrupy cough medicines should not be diluted, as dilution will lessen the soothing effect. Drugs which irritate the mucous membrane of the alimentary tract to an injurious degree should be well diluted. Saline cathartics given to lessen œdema should be diluted sparingly, while those given for cathartic purposes should be well diluted. Doses of medicines should be made as palatable as possible; drinking water should be either very hot or very cold, never lukewarm. Ice water in a clean glass given immediately after taking medicine is appreciated by the patient. Castor oil may be given by rinsing the glass with lemon or orange juice, leaving about an ounce in the glass, pouring in the oil, and covering with more lemon or orange juice sweetened to taste. Another glass containing fruit juice should follow the oil. Acids and liquid preparations containing iron should be given through a tube or straw, because they corrode or discolor the teeth. A patient never should be permitted to administer medicine to another patient. Powders and cachets should be placed far back on the tongue and hard pills or triturates should be pulverized. Absolute cleanliness in regard to measuring glasses, pipettes, tubes, and medicine glasses should be strictly observed.

Procedure for giving medicines by mouth.—Every ward should have a medicine tray holding glasses, a small pitcher for ice water, a glass rod to stir the medicines, a piece of gauze to wipe the rims of the bottles, and a small glass jar or box to hold the medicine cards. These cards are disks or squares of cardboard, which fit over the medicine glasses, and indicate the patient's name, medicine, dose, and how often it is to be given. The use of these cards will prevent mistakes when there are several medicines on the tray. When ready to

prepare medicines the tickets for the same hour of administration should be selected, and all those calling for the same medicine be grouped together. The following procedure should be strictly observed: Take the medicine glass in the left hand, read the label of the medicine bottle, take the bottle in the right hand and shake it; take the cork between the third and fourth fingers of the left hand and remove it; raise the glass until the mark representing the amount to be given is on a level with the eyes and pour the required amount into the medicine glass. If more than one patient is to receive the same medicine, the required number of doses should be poured out before wiping the bottle, recorking it, and replacing it. The label should be read again to make sure the correct medicine has been used. Small portions of ice water should then be added to cover the medicines, and the proper tickets placed on the glasses. Some empty glasses should be placed on the tray in order that the patients may be given some clear water to drink after taking the medicines. Before giving the medicine to the patient the name on the medicine card should be read again to avoid mistakes. Medicine glasses should be washed immediately and the tray left clean and ready for use when the next medications are due.

Steam inhalations may be given with an apparatus so arranged that the exit for the steam is in close proximity to the patient's nose and mouth, or a large kettle may be used and placed at a slight distance from the patient and a canopy or tent arranged above the bed, over the patient's head and shoulders, thus directing the steam toward the patient in a manner which will allow it to be inhaled.

Oxygen inhalations.—Oxygen is supplied in steel containers in which the gas is confined under considerable pressure. In administering oxygen it frequently is passed through water, with two objects in view: First, to gauge the amount being administered; and, secondly, to allow the gas to absorb moisture in order that it may have a less drying effect upon the mucous membranes. This is accomplished by leading the flow of gas through a glass flask or other closed glass container partially filled with water. By means of a tube the gas is liberated under the surface of the water. Collecting above the water in the upper part of the flask, it is led away by a tube to the patient, to whom it is administered through either a piece of tubing, a funnel, or a special mask. The key of the oxygen container should be turned sufficiently to permit the oxygen to flow into the water of the flask at the desired rate, and the funnel held away from the patient's face until the flow of oxygen has been adjusted. If too much oxygen is allowed to enter the bottle, water may be blown through the tubing. When the flow has been regulated hold the funnel near the patient's nose and mouth, but not sufficiently close to cause the exhaled air to strike against the funnel and be reinhaled.

Subcutaneous injections.—Hypodermic injections are injections of drugs or their preparations into the subcutaneous tissues of the body and are given when prompt action is required when medicines can not be taken by mouth or when secretions of the stomach or intestines interfere with the action of the drug. Drugs used for subcutaneous injection as a rule are especially prepared. They are put up in concentrated form, and great care should be taken to have them pure and sterile. Some drugs intended for this use are put in the form of compressed tablets, which should be dissolved in warm sterile water before administering. The dangers attending the use of hypodermics are: The formation of abscesses, the breaking of the hypodermic needle, and the possibility of injecting the drugs directly into the blood vessels. Abscesses are avoided by using only drugs known to be pure and sterile, by sterilizing

the hypodermic needle and syringe carefully, by cleansing the patient's skin thoroughly at the site selected for injection, and by avoiding all irritation of the subcutaneous tissue. Blunt needles and irritating medicines should be avoided. The risk of breaking a needle in the flesh may be avoided by not using a bent or defective needle and by preventing sudden movement of the part which might cause the needle to break. If the patient has never been given a hypodermic injection, it is advisable to explain what is going to be done, that it may cause slight pain, and that sudden movements during the process should be avoided. A hypodermic injection should not be given to a delirious patient without some one to assist. It should not be given over a bony prominence or near large blood vessels or on the inner side of the arms or legs where the large blood vessels are situated.

At least one hypodermic outfit should be clean and ready for immediate use at all times in cases of emergency. (Fig. 94.) The needles should be straight, sterile, and sharp. The inside of the needle will become rusted if it is not thoroughly dried and the wire inserted when not in use. To dry the bore of a needle the wire should be removed and dried with a piece of gauze, reinserted, and the process repeated until the wire is perfectly dry when removed. A dry wire is inserted before putting the needle away. When a glass syringe is used the piston should be removed before boiling to prevent destruction of the syringe by expansion of the plunger when heated. The syringe must not be

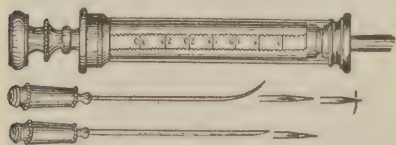


FIG. 94.—Hypodermic syringe and needles. (Wharton.)

dropped into boiling water. Metal syringes containing rubber or leather washers should not be boiled, but may be sterilized by alternately filling and emptying with a 5 per cent solution of carbolic acid, followed by alcohol, and then rinsing with sterile water. This should be done both before and after using.

In preparing tablets for hypodermic use the following procedure should be observed: If a glass syringe is used attach the needle, drop the tablet into the syringe, and add 20 minims of sterile water, insert the piston, shake the syringe to dissolve the tablet thoroughly, expel the air, and proceed to administer the contents of the syringe to the patient. If the piston can not be removed from the syringe or if it is of metal, dissolve the tablet in not more than 30 minims of warm (not over body temperature) sterile water in a sterile minim glass or sterile spoon and draw the solution into the syringe in the usual manner. Do not boil the tablet in the water, as a high degree of heat causes chemical changes in many drugs.

In giving a hypodermic injection boil the syringe and needle for one minute, attach the needle to the syringe, load the barrel of the syringe with one or two drops of sterile solution more than the desired amount, point the needle upward, press the piston until all the air bubbles disappear and only the required amount of medicine remains in the syringe. The outer surface of the arm or leg into which the medicine is to be injected, after being washed thoroughly with alcohol, is taken up and held firmly between the thumb and first finger to form a cushion of muscle and to stretch the skin. The needle is inserted quickly, preferably at an angle and preferably toward the trunk, and gentle but gradual pressure applied to the piston. (Fig. 95.) When the syringe has been emptied, remove the needle, press a sterile sponge quickly over the hole to prevent escape of the fluid, examine the needle to make sure it is intact, knead the spot gently for a few seconds, and clean the syringe and needle, carefully

drying and replacing the wire. Great care must be taken not to allow air to be injected into the tissues, as it may enter the circulation and cause grave complications or death.

Care and comfort of a patient.

In the care of patients, especially fever patients, the following general rules, subject to modification by the medical officer, should be observed: Provide plenty of fresh air without causing draughts; guard against glaring light in the patient's eyes; observe extreme cleanliness, both with regard to the patient and to yourself; apply cold to the patient's head and heat to his feet, if necessary; keep the mouth, tongue, and teeth clean at all times of the day or night; and give necessary cooling drinks frequently. A delirious patient never should be left unattended. The prescribed diet should be carefully followed. A notation should be made of evacuation of the bowels and bladder, and any abnormalities present should be brought to the attention of the medical officer.

Carrying out orders and administering treatments and medicines are not all that is necessary in the care of patients. Prompt recognition of changes in the condition of a patient and good nursing, when it is a question of life or death, may be the deciding factor in saving a life.

Rest means that the vital organs, especially the heart, are to be spared all unnecessary effort. In order to accomplish this the patient not only must be kept quiet in bed, but all excitement, anxiety, and annoyance must be prevented. When a person has fever, it takes very little to arouse excitement or cause anxiety, therefore, he never should be told about anything going on in any other part of the hospital, nor should he know the facts contained on his clinical chart. Under no circumstances should a nurse or hospital corpsman discuss the patient's condition in his presence. Seemingly unconscious patients often hear every word. Never whisper near a patient, as it is very annoying to an ill person. Trivial things which a patient would not notice when well may be a source of great irritation when sick. Actions which hardly would seem an effort or require much energy, such as holding a glass, drinking very rapidly, or trying to drink out of glass instead of using a drinking tube, often exhaust the patient. A weak patient never should be permitted to turn or move unaided. Patients have been known to fall back dead after slight exertions similar to those mentioned above.



FIG. 95.—Method of giving a hypodermic injection. (Wharton.)

To secure the comfort of a patient and prevent the development of bed-sores, fatigue, or exhaustion the position should be changed occasionally; change the position of pillows as soon as they become disordered and uncomfortable; when the patient is very thin, relieve pressure on bony prominences with air rings or pads made of cotton or gauze; flex the knees to relieve abdominal strain or pain; support the bed clothing with a cradle when its weight causes discomfort to any part of the body; and when a weak person sits up or lies on the side furnish support with pillows, which should be so arranged that the patient will not be required to use any effort to maintain the position.

To give and remove a bedpan.—The bedpan must be warm and dry. Flex the patient's knees if possible, pass one hand under the sacrum, gently raise him, and insert the pan. When removing the bedpan it is necessary to raise the

patient in the same manner, for if an attempt to remove the bedpan without doing so is made the fluid contents may be spilled on the bed, or the rubbing of the bedpan on the skin may cause an abrasion which readily will develop into a bedsore. After using the bedpan the patient should be cleaned with warm water and soap and carefully dried.

Care of the mouth.—Convalescent patients and those who are not very ill require the same daily cleansing and washing of the mouth and teeth as does a healthy person. A fever patient, however, requires special attention and faithful care, since with a high temperature there is likely to be an insufficiency of the secretions of the mouth which in health tend to keep the mouth moist and clean. This may be the result of inactivity of the glands of the mouth or the rapid evaporation of the moisture on account of the high fever. Whatever its cause may be, if this condition persists for any length of time, the membranes will become very dry and crack, and only the greatest care will prevent the appearance of either sordes or herpes, which in turn may develop into very serious complications. A fever patient's mouth should be washed after every feeding, whether the food is fluid or solid. This applies to the patient both at night and during the day. Carelessness of the night watch may undo all the faithful work of the previous day. One thorough cleansing should be given in the morning as well as in the evening. By this is meant that the tongue should be well scrubbed with a piece of gauze on a tongue depressor, the teeth cleansed with gauze, and dental floss used to remove any retained food material between them. If the mouth is too sore to use a toothbrush, a piece of gauze may be wrapped around the finger and the teeth cleansed with it, after which the patient should rinse the mouth with an antiseptic mouth wash (Dobell's solution or a solution of boric acid and lemon juice with a few drops of tincture of myrrh added). The tongue never should be scrubbed after feeding, as the patient might be inclined to vomit, especially if the back of the throat is touched. The best time to do this is about 10 minutes before a feeding is due. Fever patients should be given a glass of water after each feeding and frequently between feedings. This not only helps to keep the mouth moist and clean, but also flushes the kidneys and assists in reducing the fever.

Rubs.—In order to give an acceptable rub or to handle a patient with comfort to him, the hospital corpsman must take care of his hands. Rough, hard, cold hands can not but annoy, while a soft, smooth, warm, gentle hand brings infinite comfort.

In rubbing with alcohol, wet the hand just enough so that it does not drip. On the arms and legs use both hands for rubbing, on the chest and back usually but one. The stroke should be rather long, not too quick, firm enough to stir the circulation, yet light enough to glide over the skin without pulling. Try all the time to think of the muscles and blood vessels under your hand, and endeavor to reach and stir them. Forget the skin as far as possible, except that you are not to let your fingers pull or pinch it. Use the whole hand, palm, and fingers, almost grasping the flesh with it. Do not use the ends of the fingers too much.

Counterirritants are substances which when applied to any area of the body surface will produce irritation of the sensory nerve endings lying beneath the surface. This process relieves congestion and inflammation in either an adjoining part or some distant part. The principal uses of counterirritants are to relieve congestion and inflammation as in tonsillitis, pneumonia, and headache; to promote absorption of serous effusions, as in pleurisy, and exudates around joints; to stimulate nerve centers in collapse; and to increase peri-

stalsis and thus overcome tympanites. Substances used as counterirritants produce different stages of irritation according to their strength and the length of time applied and are known as *rubefacients* or reddeners, which cause the superficial vessels to dilate and redden the skin; *vesicants* which produce a blister; and caustics or *escharotics*, which cause a burn or sloughing. (See chapter on *Materia Medica*.)

Rubefacients, in general use, are heat (both dry and moist), mustard pastes, flaxseed poultices, stupes, cupping, and certain liniments. Unless special care is exercised in the use of rubefacients, blisters may be caused which, unlike those resulting from vesicants, may be very slow in healing, and may become infected.

Vesicants are applied especially for the purpose of causing absorption or removal of inflammatory deposits after true inflammation has ceased. (The one most frequently used is cantharidal collodion.) Caustics or escharotics in common use are silver nitrate and actual cautery.

Stupes, or hot fomentations, are prepared by placing two layers of flannel in boiling water, wringing as dry as possible by means of a canvas or towel and applying directly to the skin, which has been greased with petrolatum to prevent blistering. The flannels are covered with a light rubber sheeting or heavier flannel and kept in place with a bandage or binder, and are changed frequently. They usually are allowed to remain over a period of from 20 minutes to 1 hour, or as directed. If the stupes are ordered over a broken surface, sterile gauze should be used and wrung dry by means of a sterile towel, observing the strictest asepsis in regard to water, hands, material, etc.

The most desirable manner of using *turpentine stupes* is to mix the turpentine with oil, in the proportion of one part of turpentine to two of oil for an adult, one part of turpentine to six of oil for children. This is applied to the area of the skin desired and the hot flannel then applied. The oil and turpentine must be well stirred before each application.

Mustard sinapisms (plasters) are used in the form of a mustard paste or mustard leaf. The paste is made from flour and warm water, into which mustard is stirred in the proportion desired, usually varying from one-eighth to one-half, the latter proportion for applications to the chest. If the skin is sensitive the white of an egg should be mixed with the mustard. Spread the paste on thick muslin, turn in the edges, and cover the surface next to the skin with gauze. This application generally is allowed to remain not longer than 15 minutes, and should be watched carefully. Certain individuals blister more readily than others. After removing, if the skin is very red, a bland ointment should be applied. If the official mustard leaf is used, it should be dipped in tepid water, allowed to drip, applied directly to the skin or on a layer of thin muslin, allowed to remain for 5 or 10 minutes, and watched carefully to avoid blistering. After removal the surface should be dried and kept covered until all redness has disappeared.

Poultices are applications of substances which when parboiled retain heat and moisture. Flaxseed meal is used most commonly for poultices. In preparing a flaxseed poultice the water must be boiling and all appliances must be at hand to prevent the poultice from cooling during preparation. The muslin to hold the poultice should be 2 inches larger than the required poultice. The flaxseed meal should be stirred into the boiling water, and when the mixture is cohesive and does not adhere to the sides of the saucepan it is spread upon muslin and smoothed with a spatula to a thickness of three-quarters of an inch, dipping the spatula in boiling water frequently. The margins of the muslin should be turned in and the poultice rolled into a warm towel or car-

ried to the patient on a hot-water bag. Before applying, the poultice should be tested against the cheek and then applied directly to the skin, provided the poultice does not contain an irritating ingredient. It should be covered with thin rubber sheeting and with a layer of cotton kept in place by means of a binder or bandage and removed in an hour or as soon as it becomes cold. Upon removal the surface should be dried, the skin carefully observed and covered with a layer of warm cotton, which should remain until the next application or until removal is directed.

Cupping is the application to the surface of the skin of glass cups in which a vacuum has been created by the use of heat or with a pump or a rubber bulb. (Fig. 96.) As a result of the vacuum the tissue under the cups is forced into them. This results in the hyperemia of this tissue both as a local effect and for the relief of congestion in underlying structures. Cups provided with pumps and bulbs are known as Bier's cups, named after the inventor, and vary in shape and size (usually one cup is used to cover the entire area). Another method is to create a vacuum by means of heat, and when so done a number of cups are used at the same time. The cups must be dry, especially the rim.

The inside of the cup is moistened with cotton soaked in alcohol, care being taken to avoid having any alcohol on the rim of the cup. Then ignite the alcohol which is retained on the inner surface of the cup, and before the flame is extinguished invert the cup and hold for a second to make certain no alcohol

has collected. Apply immediately to the affected area. In removing cups never pull them off, but insert under the rim a small portion of the handle of a spoon or other suitable object which has been thoroughly cleaned, elevate slightly to permit



FIG. 96.—Cupping glass and air pump. (Wharton.)

the admission of air and destroy the vacuum. Before applying cups by this method a blanket should be obtained and placed where it will be available in the event of an accident (fire).

In applying a Bier's cup with a bulb select one large enough to extend about 1 inch beyond the inflamed area, oil the edges with vaseline, place the cup in position, and gently squeeze the bulb. As the bulb resumes its shape a vacuum will be created in the cup. This will cause the tissue to rise within the cup. If the pump method is used, the air should not be exhausted too quickly or too extensively; to do so may cause pain and discomfort to the patient. The color of the skin should be watched carefully, and pumping should cease when the skin assumes a mottled appearance or if the patient complains of pain.

In using a Spanish-fly or cantharidal collodion *blister* the skin should be surgically prepared and the collodion then applied to the selected surface by means of a camel's-hair brush, having first outlined the area with vaseline. The application should be allowed to dry for a few minutes and then be covered with gauze and oiled-silk or waxed paper, and examined from time to time. It usually takes from four to eight hours for a blister to form. If a blister does not form within this time, the application should be removed and a poultice applied over the site. After the blister has been raised, it should be aseptically opened, the fluid gently pressed out with sterile cotton, and a dry sterile dressing applied. Strict aseptic precautions are necessary.

Cold applications frequently are used in the treatment of inflammation, because of the depressing action of the cold on the activity of the circulation. Cold inhibits the multiplication of bacteria and also the forming of toxins.

It relieves pain by causing contraction of the blood vessels, thus relieving congestion, and by reducing the irritability of the sensory nerve endings.

Cold usually is applied in the form of ice, iced water, and iced solutions by the use of ice caps, ice coils, compresses, local baths or irrigations.

In using *ice caps* the ice should be broken into pieces about the size of a walnut, using a canvas bag and mallet. After half filling the bag the air should be expelled and the cap securely screwed down. The bag should not be more than three-quarters full and always should be covered with gauze. After use the surface of the bag should be washed with a disinfectant and hung up to dry before putting away.

Cold compresses consist of several layers of gauze or absorbent cotton immersed in cold water or iced water, wrung out to remove the excess water, and applied to the desired part. These compresses must be changed very frequently in order to keep the part cold. Eye and throat compresses are the most commonly used cold compresses. Absorbent cotton should be used for the eye compresses, the pad consisting of several layers of cotton a little larger than the eye in size but not large enough to extend over the bridge of the nose. If both eyes are to be treated, separate pads and separate basins of iced water should be used for each eye. When there is discharge from the eye the same compress must never be used more than once. A receptacle should be provided, in which to throw the soiled compresses. A compress should not be allowed to remain on a part until it becomes warm.

Hot applications are applied for the stimulating effect (heat expands the tissues and thus increases hyperemia to a greater degree than any of the other counterirritants). Moist heat induces softening of the tissues and at the temperature attained by the use of poultices, if applied directly over an inflamed area, will favor suppuration. For this reason the use of poultices sometimes may produce harmful results. Moist heat is more penetrating than dry heat. Counterirritation by heat usually is produced by the use of hot-water bags, hot-air baths, compresses, poultices, stupes, and by electric pads.

Hot-water bags.—The water must not be hot enough to scald; the bag should be half full; superfluous air should be forced out of the bag before the cap is screwed on; an uncovered hot-water bag should never be given to patient, and care should be taken that a blanket intervenes between the covered bag and the body of an unconscious patient. Post-operative patients require special care when hot-water bags are applied and should not be left alone while the hot-water bags are in his bed. A hospital corpsman never should take a patient's word concerning the temperature of a bag, but should judge for himself and carefully watch the skin for reaction.

The use of *electric pads* requires important precautions. When these appliances are used the hospital corpsman should make sure that the insulating material around the wires is intact; otherwise the bedclothes may be set on fire. It should be remembered that if the pad is used continuously for any length of time its temperature will increase and it may burn the patient, the heat causing the perspiration to scald him.

Hot wet dressings should be applied in the form of fluffed gauze or rolled gauze compresses wrung out of a hot antiseptic or sterile solution. They should be applied and covered with thin oiled silk or rubber sheeting to protect the bedclothes and mattress, and a hot-water bag should be placed outside of the rubber sheeting to maintain the heat. Precautions should be taken against permitting a wet dressing to become cold, especially at night; carelessness may result in the development of serious complications.

A *pneumonia jacket* or chest protector may be made of soft flannel, double thickness, or of cotton placed between two layers of gauze cut to fit the body. It should have arm holes and shoulder pieces and should cover the thorax. One side should be left open and fastened with tapes under the arm and over the shoulder. The cotton should be held in place by stitches.

Bed making.

Making beds correctly is one of the first things a hospital corpsman should learn. Neatly and correctly made beds add greatly to the appearance of a ward and to the comfort of the patients. Loose and sagging beds should not be used and special care should be taken to prevent bed coverings from becoming too tight for the patient's comfort. Whenever a patient is temporarily out of the bed occupied the bed should be straightened and smoothed before the return of the patient.

The method of making beds varies in the different hospitals. At some the spread is tucked in and at others it is not; at some a blanket is rolled and placed at the foot of the spread while at others it is not. The fundamental principles, however, are the same at all hospitals, namely, protection of the mattress, cleanliness, tightness of the under and draw sheets, and warmth for the comfort of the patient.

A mattress always should be protected with a mattress cover, a linen cover being washed and sterilized more easily than the mattress. The moisture in sterilizing often ruins the mattress. The bed linen should be changed as often as necessary, but economy should be practiced where laundry conditions are unfavorable and where there is a scarcity of linen. Care should be taken to avoid placing badly stained linen on beds. The under and draw sheets should be drawn tight to prevent the formation of wrinkles under the patient, which makes possible the development of bedsores. There should be sufficient covering to keep the patient warm and, while it is necessary to have the bedclothes look neat and tight, care should be taken to avoid the causing of pressure sores on the toes. Beds and bedding should be kept free from vermin. If signs of bedbugs appear the bed should be cleaned with a disinfectant solution and the bedding and mattress sterilized by steam. It is imperative that no clothing, papers, books, food, pipes, tobacco, or other articles be kept under the pillows or mattresses.

The proper manner of making a bed is to obtain all the necessary bedding, put it in a place convenient to the bed, remove all clothing which may be on the bed and turn the mattress either from top to bottom or from side to side.

(1) The mattress cover should be placed over the mattress from the head to foot, corners neatly fitted and the tapes tied at the foot of the mattress. (2) The bottom sheet should be placed on the mattress right side uppermost with the wide hem at the head of the bed, and so arranged that it hangs equally over the sides of the mattress. The wide hem should be folded over the head of the mattress and an 18-inch tuck made with envelope corners at each side. The sheet then is pulled down to the foot of the bed, made taut and the sides tightly tucked in. (3) The top sheet is placed on the bed wrong side uppermost with the wide hem toward the head of the bed and even with the upper edge of the mattress. It should be placed so that it hangs equally over the sides. The end is folded smoothly under the foot of the mattress, envelope corners made and the sheet freed from wrinkles. (4) Next the blanket is placed on the bed in such a manner that it hangs equally at the sides and is 6 inches from the head of the bed. The blanket then is folded over the foot of the mattress, tucked in, envelope corners made, and the entire blanket freed from wrinkles. (5) The

spread next is placed in such a manner that it will be right side uppermost (anchor pointing to the lower left corner of the bed), hanging equally at the sides and should just cover the blanket at the head end. The foot end then is folded smoothly under the mattress, tucked in, envelope corners made, and freed from wrinkles. (6) The upper part of the sheet extending beyond the blanket and spread should be folded back over them and the spread, blanket, and sheet tucked in tightly at the sides or allowed to hang in accordance with the local rules. (7) Pillow cases are applied to the pillows, arranged in such a manner that the corners will be well filled and then placed at the head of the bed with the seam to the back and the closed end toward the entrance of the ward.

Fracture bed.—This type of bed differs from the ordinary bed in that a full sized perforated board, a frame of slats, or a number of slats are placed between the springs and mattress to prevent any motion at the point of fracture by sagging of the mattress.

Ether bed.—This sometimes is called an anæsthetic bed, and it is prepared especially for patients who are or have recently been anæsthetized. It resembles an ordinary bed, except for the fact that the upper sheet, blanket, and spread are tucked in at the bottom but not at the sides and are neatly folded, fanlike, at the foot of the bed. A rubber sheet is placed across the center of the bed, about the distance of a pillow from the head of the bed, tucked in smoothly on both sides, and covered with a drawsheet, which is an ordinary sheet folded crosswise to cover the rubber and extending 2 inches beyond the rubber at the top and bottom. This sheet is tucked in smoothly and tightly on both sides and a rubber pillow cover or small rubber sheet covered with a towel secured at the head of the bed in place of the regular pillow and the towel secured to the mattress with safety pins. The pillow should be placed on edge against the head bars of the bed and fastened to them with two strips of gauze bandage. At least two hot-water bags should be placed on the bed and the whole bed covered with an extra blanket turned up at the sides, in order that the entire blanket and the bed may become warm before the patient returns from the operating room and is placed in it. The hot-water bags should be removed from the bed immediately prior to arrival of the patient. A suit of clean pajamas should be wrapped around the hot-water bags to warm and when required placed on the patient. The following articles should be placed on the bedside locker: Towels, gauze, two pus basins, mouth gag, tongue forceps, clock or watch, pencil and paper, and on the floor at the foot of the bed a set of shock blocks upon which to raise the foot of the bed in case of severe shock.

Changing the mattress with the patient in bed may be accomplished as follows. The spread should be folded neatly and placed on a chair. The sides of the upper sheet and blanket should be folded over the patient, and the bottom part of it folded under the legs. The pillows should be removed, the lower sheets loosened and the sides of the sheets including the rubber sheet rolled close to the patient. One side of the rolled sheet then should be pulled, drawing the patient toward your side of the mattress, an assistant should stand on the opposite side of the bed and draw the mattress toward his side until half of the springs are exposed. This exposed part is covered with a fresh mattress, the patient drawn upon it, the old mattress discarded and the fresh mattress pulled into position. The patient should be drawn toward the center of the bed, and the making up of the bed continued. If the under sheets are to be changed, the vacant half of the mattress should be changed with fresh linen, and before the patient is drawn to the center of the bed, the patient lifted (with some assistance) on to the clean side, the

soiled linen removed, the clean sheets drawn over the remainder of the mattress, and the making of the bed completed.

Turning the mattress with the patient in bed.—This may be accomplished in a manner similar to changing the mattress, except that after drawing the mattress to one side of the bed, the springs should be covered with three pillows and the patient lifted on to them. The mattress then is turned top to bottom, the patient lifted back on the mattress, and the bed made up as before.

Changing lower sheet of bed patient.—In making this change it is necessary to loosen all of the clothing from the head, foot, and sides of the mattress, and to remove the pillows and all upper clothing except the sheet. The patient then is turned on one side. The lower sheet is folded or rolled lengthwise close to the patient's back and a clean sheet folded or rolled lengthwise to its middle and placed close up to the soiled sheet. The patient is turned on his opposite side, the soiled clothes removed, the clean sheet freed from wrinkles and tucked in at the head and sides to make it taut. If a drawsheet is present it should be removed with the soiled sheet and a clean drawsheet folded or rolled and placed in its correct position at the same time and in the same manner as the lower sheet. If it is impossible to turn the patient upon his side, assistance should be obtained. With an assistant on the opposite side of the bed, it is possible to loosen the clothing all around, and to remove the pillow. The head, shoulders, body, and hips are supported in that order while the soiled sheet is folded or rolled and gradually removed from head to foot, following it up with a clean sheet which has been rolled or folded and which is unrolled or unfolded as the soiled one is withdrawn.

Changing clothing of a helpless or unconscious patient.—If the sleeves do not slip off readily, one hand should be slipped through the armhole, the patient's arm grasped above the elbow, bent slightly, and gently drawn backward, while with the other hand the sleeve is removed by pulling the armhole or the wrist. If the arm is injured, the sleeve of the injured arm is removed last, but in putting on the pajama coat, the injured arm is put in first. The pajama coat should be pulled well down in the back in order to avoid wrinkles. In the case of helpless and unconscious patients it is better to have the pajama coat buttoned in the back. The most efficient way to remove a coat from a helpless patient, is to draw it well up to the shoulders, then bring it over the head, taking out first one arm and then the other. The trousers are pulled down to the ankles, both legs are lifted with one arm, and the trousers removed with the free hand. If the leg or foot is injured or swollen the trouser leg should be cut at the seam to facilitate repair.

Moving and lifting patients.—Before being lifted a patient should be drawn to the edge of the bed, thus minimizing the degree of stooping required. When stooping is unavoidable, the lifter should bend his knees and hips, throw back his shoulders and retain them in that position. Before lifting, the patient should be instructed to make himself rigid, and to remain so while being lifted. When two or more persons are lifting a patient, it should be done in unison, one directing and giving the word to start when ready, but when carrying a patient one carrier should step off with the right foot and the other with the left, to prevent swinging.

In moving a helpless patient to the side of the bed, his head and shoulders should be supported with one arm and the other arm gently placed under the small of his back. The assistant standing on the same side of the bed should pass one arm under the upper part of the patient's thighs, and the other under his knees. The patient thus can be lifted easily to one side of the bed. A

heavy patient may be turned or moved more easily by loosening the drawsheet and pulling it to one side of the bed, or by grasping the loosened end of the sheet on a line with the shoulders and thighs and then gently pulling it upward and turning the patient on his side.

A weak or helpless patient should be turned on his side by placing one arm under his far shoulder, obliquely across the back in such a manner that the hand comes under the patient's near side; the other arm should be placed under his hips from the far side, the patient raised slightly and drawn somewhat backward, and turned toward the attendant. It may be necessary to make some change in the position of the patient's shoulders or hips. In moving the shoulders of a helpless patient the hospital corpsman's arms should be placed on either side of the patient's body, bringing the hands under the lower arm, then the patient should be raised slightly and moved as required. The hips should be moved in the same manner.

Restraining apparatus.—The appliances commonly provided in hospitals for the restraint of violent patients are the straight jacket, made of soft canvas, with sleeves sewed to the sides, and buckles arranged so that the patient can be strapped into it without suffering any discomfort; and leather cuffs of sizes to fit the wrists and ankles, commonly known as anklets or wristlets. Sheets and strips of canvas often are substituted for these in restraining the arms and thighs. No attempt should be made to restrain a patient without assistance, and when a patient is delirious or insane he should not be restrained and left without a guard; under these conditions he may devise means of escape. In restraining the arms and legs, interference with circulation should be avoided. If appliances are not well padded, chafing and ulceration may result, and if the patient struggles, constant watch should be kept to prevent the restraint from becoming tightened. This applies especially when the jacket is used, and care must be taken to see that the patient's respiratory movements are unhampered. The pulse and general condition of a delirious patient struggling against restraint should be watched carefully; sudden death not infrequently occurs during this state. The extra work thrown upon the patient's heart by the violent movements often produces conditions which can not be compensated.

The care of the dead and the disposition of patient's effects are discussed in the section on Deaths and Medico-legal Matters.

As soon as a patient is pronounced dead by a medical officer this entry should be made on the chart: "Patient pronounced dead," followed by the hour, minute, and the name of the doctor who pronounced the death.

Massage is discussed in the chapter on Physiotherapy.

RECOGNITION AND PREVENTION OF DISEASE; GENERAL PRINCIPLES GOVERNING THE CARE OF PATIENTS.

Communicable diseases are those which may be transmitted from one person to another and gain entrance into the body by way of the mouth and nose (respiratory and alimentary tracts), from contaminated food and drink, droplets from breath, infected dishes, linen, contaminated articles, by bites of infected insects (mosquitoes, body lice, fleas, flies), and by entrance of infective agents through abrasions of the skin and mucous membranes.

Communicable diseases are described in the chapter on Preventive Medicine, Hygiene, and Sanitation. A few of the common diseases are mentioned hereafter with a short description of the nursing care necessary in the treatment.

Some of the common eruptive diseases are: German measles, measles, scarlet fever, smallpox, chicken pox. Water-borne diseases are: Typhoid fever, dysen-

tery, and cholera. Those caused by the bite of an insect: Malaria, yellow fever, dengue, typhus. Those caused by entrance of infective agents through abrasions of the skin: Tetanus, septicæmia, erysipelas, and gas bacillus infection. Diseases of the respiratory tract are: Bronchitis, influenza, pneumonia, and tuberculosis. Those caused by special organisms: Tonsillitis, Vincent's angina, diphtheria, and meningitis. Some of the special diseases which are not communicable but often occur as complications or sequelæ of communicable diseases are: Acute endocarditis, pleurisy, rheumatic fever, nephritis.

Active and passive immunity are described in the chapter on Bacteriology, Blood Work, and Immunity.

Symptoms of a disease may be defined as "Any evidence of disease or of a disordered condition; a change in the body or its functions indicative of some abnormal bodily or mental state." *Physical signs* are described as "conditions that can be seen, heard, or felt by the diagnostician" (inspection, auscultation, palpation, and percussion). Symptoms may be divided into two classes: *Objective*, those observed by the onlooker; and *subjective*, those complained of by the patient but not seen by the observer, such as pain, discomfort, and nausea.

Some of the important symptoms are: Changes in the temperature, pulse, respiration, color of skin, facial expression, appearance of eyes, mental condition, odor of breath, etc.

In observing the condition of the body, the following should be looked for: Emaciation, sores, and eruptions, including the type and location; swellings, especially of the face or feet; the presence and location of abnormal prominences; involuntary twitchings of muscular contractions, local or general; and any other abnormalities.

The position a patient's body assumes should be noted and the location and character of any pain observed. The position of the body during sleep is also important.

Perspiration, if warm, is natural during crisis or following high fevers and is considered as a favorable symptom; if the perspiration is cold and the body has a clammy feeling the symptoms are not favorable. Profuse periodic attacks of perspiration occur in rheumatic fever and in tuberculosis, especially at night. A chill should be observed for its duration and severity. The condition of the nose, throat, mouth, teeth, and tongue should be carefully noted.

Sensitiveness, especially in the abdomen, is important. The amount of urine voided during 24 hours should be noted and the appearance described. Stools should be observed for color, form, consistency, and odor.

Personal prophylactic measures (voluntary) consist of: Sufficient and proper nourishment; an adequate amount of fresh air and sunshine; avoidance of excessive fatigue and overworking of any one part of the body; keeping the system properly flushed (regular movements of the bowels and passage of normal amounts of urine); and training the body to react to sudden alternation of heat and cold. Involuntary measures consist of: The normal secretions of the body (hydrochloric acid in the stomach; the alkaline digestive juices) and the presence and action of antibodies (immunity producing agents) in the body.

General prophylactic measures consist of: Isolation; sunshine; and the proper disposition of discharges, droplets, and excreta containing bacteria.

Gauze handkerchiefs and paper sputum cups should be burned; thermometers, dishes, utensils, and linen sterilized or disinfected; and the hands thoroughly scrubbed under running water and soap for at least three minutes, followed by the application of a disinfectant hand lotion. Excreta should be covered until such time as it may be disposed of readily by disinfection or burning. All

doors and windows should be screened properly, especially in malaria and yellow fever cases. When screens are not available cotton netting should be used over the patients. All insects should be killed.

The general nursing care of all diseases consists of: Absolute cleanliness; plenty of fresh air; proper ventilation; daily bath as ordered; cleansing of mouth before and after feeding; forcing of fluids, unless otherwise directed; and giving the prescribed diet regularly. Care should be taken to observe and chart stools and urine; to wash the buttocks after each stool; to take and chart temperature, pulse, and respiration conscientiously, at regular intervals, noting the character of pulse and respirations; to give medicines accurately and at the proper time; and to change the patient's position frequently. When fever is present the patient's mouth should be sprayed frequently; the lips moistened with liquid petrolatum; and the back and pressure surfaces rubbed at least twice daily, or more frequently, if necessary.

The hospital corpsman caring for patients with communicable diseases should observe the following rules: Wear a cap and gown in the ward or room; wash the face and hands with tincture of green soap before meals and before leaving the ward; wash the hands with some antiseptic solution after handling the patient or contaminated articles; when irrigating a diphtheria patient's throat wear glasses and a gauze mask over mouth and nose, and take a daily walk in fresh air or light exercises daily.

A medical officer visiting cases of communicable disease should wear a gown which when not in use should be folded in such a manner that the inside is kept clean. If it is hung in the patient's room, the contaminated side should be out; if hung in an outside room, the contaminated side should be folded in. A basin of hot water, tincture of green soap, and clean towels should be in readiness for the doctor's use upon completion of his visit.

The following points are important in the after care of patients who have had communicable diseases. A thorough cleansing bath, including the hair, should be given prior to the discharge or transfer from the ward; the clothing worn in the ward should be sterilized before removing, as should also the hammock, etc., before storing in the bag room. After removal of the patient all windows should be opened and all curtains removed to admit plenty of fresh air and sunshine, and the walls and all furniture should be washed thoroughly with soap and water. All mattresses, pillows, and blankets should be sterilized immediately; the linen, gowns, etc., sterilized or disinfected before sending to the laundry; the dishes and utensils if isolated should be sterilized or disinfected before returning them to their proper places; and the thermometers entirely covered with a disinfectant solution and soaked for 20 to 30 minutes.

The following is a brief description of a few of the communicable diseases which a hospital corpsman frequently is called upon to nurse. (See chapter on Preventive Medicine, Hygiene, and Sanitation for a more complete description.)

Eruptive diseases.

Measles.—*Cause* is an unknown filterable virus; *incubation* period is from 7 to 18 days; symptoms are coryza, sneezing, cough, nausea, vomiting, chilliness. Fever, first day, 102° to 104° F., which on the third day gradually drops and then rises with the appearance of the eruption, the temperature dropping by lysis as the rash fades. The *eruption* is seen first on the mucous membranes of the cheeks, prior to its appearance on the skin. On the third or fourth day it appears on the chin or forehead, sides of the neck, face, and the body. It consists of red, elevated spots which run together, forming crescent-shaped blotches.

Common complications of measles are: Broncho-pneumonia, laryngitis, otitis media. The nursing care consists of darkening the room or shading the eyes, forbidding the patient to read and washing the eyes frequently with boric-acid solution. The nose, mouth, and throat should be kept clean and the room warm and free from draughts. Itching of the skin may be troublesome and may be relieved by cocoa butter rubs.

German measles.—*Cause* is unknown; *incubation* period is from 10 to 21 days. *Symptoms* are headache, nausea, vomiting, conjunctivitis, pharyngitis, swelling of the glands of the neck, especially those behind and just below the ears, and slight febrile rise. The temperature for a short time may be quite high. In some cases the symptoms are so slight that the patient hardly seems to be sick. It frequently happens that the first knowledge a patient has of the disease is the appearance of the eruption. The rash and the swollen glands are the two principal diagnostic symptoms. The *eruption* appears within 24 to 48 hours, first on the face, spreading over the entire body, usually beginning to fade on the second day. It consists of large, isolated, pinkish macules, resembling the rash of measles, or small, bright red macules, close together, resembling the rash of scarlet fever but without the characteristic stippling of the latter disease. The eruption, which usually is altogether out of proportion to the constitutional symptoms, sometimes presents a papular appearance and occasionally consists of small vesicles, which may appear in crops. Pneumonia, nephritis, intestinal disorders, and suppuration of the enlarged glands are complications which may occur. The nursing care consists of quietness and rest in bed for at least one week, hot or cold applications to the neck, washing the eyes frequently with boric-acid solution, relieving itching of the skin (if present) with cocoa-butter rubs and keeping the nose, mouth, and throat clean.

Scarlet fever.—*Cause* is unknown; *incubation* period is from 2 to 7 days, usually 3 or 4. *Symptoms* are chill, sore throat, headache, strawberry tongue, and eruption. The temperature is 104° to 105° F. for the first four or five days, dropping by lysis. The *eruption* appears within 18 to 36 hours, first on the chest and neck, then on the back, face, arms, legs, hands, and feet. It is pin point in appearance, usually scarlet red, very diffuse, and disappears upon pressure. Desquamation takes place in long strips at the expiration of a week or 10 days, and continues from one to seven weeks. Some possible complications are: Otitis media, acute endocarditis, nephritis, and arthritis. Chronic endocarditis and myocarditis, chronic nephritis, blindness, deafness, and paralysis may be the sequelae to this disease. The nursing care consists of keeping the room warm and free from drafts, and carefully observing the urine, which should be measured, and the appearance and amount charted.

Smallpox.—*Cause* is unknown; *incubation* period generally is from 10 to 14 days; and the *symptoms* are characterized by a sudden onset, chill, vomiting, and severe headache and intense backache. The temperature is from 103° to 105° F., until the rash appears, at which time it falls. Pustules are formed, usually at the end of the ninth day, associated with a rise of temperature which after several days drops by lysis. The *eruption* appears on the third day on the palms, soles, and the hair line of the forehead, the first stage being characterized by a hard lump under the skin, the second stage by vesicles above the skin, and the third stage by the appearance of pus in the vesicles. Only one stage is present at a time. Some possible complications are septicaemia, pyaemia, myocarditis, nephritis, pharyngitis, abscesses, and cellulitis. The nursing care consists of washing the pus from the lesions with a disin-

fectant, applying oil or vaseline to relieve itching, encasing the hands in cotton gloves, and irrigating the eyes every two hours. Hospital corpsmen caring for a smallpox case should have been vaccinated recently.

Chicken pox.—*Cause* is unknown; the *incubation* period is from 2 to 3 weeks; and the *symptoms* are chilliness, mild headache, and a temperature of 100° to 102° F., for the first two or three days, at the end of which time it returns to normal. The *eruption* appears within 24 hours in crops on the trunk, back, and chest, all stages being present at the same time, new crops coming out before the old ones have disappeared. The skin lesions are very itchy. The nursing care consists of sponging and oiling the skin daily, and using cotton gloves, if necessary.

Mumps.—*Cause* is unknown; the *incubation* period is from 12 to 26 days; and the *symptoms* are headache, nausea, pains and swelling of parotid glands (just below and in front of the ear). The temperature in mild cases varies from 100° to 102° F., in severe cases it may reach 105° F. Some common complications are earache, otitis media, and orchitis. The nursing care consists of retaining the patient in bed and keeping him warm until the swelling disappears.

Water-borne diseases.

Typhoid fever.—*Caused* by the *Bacillus typhosus*; the *incubation* period is from 7 to 21 days; and the *symptoms* are, at the onset, headache, nausea, pain in back, legs, and abdomen, loss of appetite, coated tongue, epistaxis, diarrhœa, and frequently bronchitis. Later the spleen becomes enlarged, the Widal reaction becomes positive, stools become liquid yellow (pea-soup appearance), or the patient may be constipated. The temperature during the first week rises a degree or a degree and a half higher each evening and drops slightly each morning. During the second week it remains continuously high (103° to 104° F.), with a very slight morning remission, and during the third week the remissions are more marked; in favorable cases the decline is gradual and in mild cases the temperature reaches normal at the end of the third week. The majority of normal cases end in the fourth week of the disease. The pulse varies from 80 to 100, is dicrotic and slow in proportion to fever. Hæmorrhage and perforation of the intestines are indicated by a sudden, rapid, and weak pulse, associated with marked rapid fall of temperature. The tongue is coated white at first, and later becomes very dry and brown or black in the center. The approach of convalescence is indicated when the tongue begins to moisten and become clear around the edges. The mental condition is usually dull and stupid and frequently is accompanied by delirium. A continued low, muttering delirium, with picking at the bedclothes, is an unfavorable symptom. A typhoid-fever patient never should be left unattended. The *eruption* or rash appears as small, rose-colored spots on the abdomen, the lower part of the chest, and the back, which disappear temporarily upon pressure. It develops after 7 to 10 days, lasts 2 to 3 days, and then fades, leaving a brownish stain for a time. Successive crops of this rash form until the middle of the third week. Some common complications are tympanites, hæmorrhage from the intestines, perforation of the intestines, and dilation of the heart. Endocarditis, empyæma, periostitis, meningitis, pneumonia, deafness, phlebitis, and thrombosis may be the sequelæ. The nursing care consists of carefully watching the patient's position, which should be recumbent and changed frequently, and support being afforded with pillows. All exertion on the part of the patient must be avoided, and he should have absolute rest. The mouth should be kept clean, guarding against reinfection; the prescribed diet should be strictly adhered to and plenty of water

should be given. Daily enemata usually are prescribed if necessary. No cathartics should be given, and the buttocks should be washed after each stool. Special care should be observed to prevent bedsores.

Bacillary dysentery.—Caused by *Bacillus dysenteriae*; is highly infectious and is characterized by a sudden onset, frequent small stools, containing blood, mucus, pus, and very little feces, and accompanied by tenesmus, with pain and tenderness over the colon. In severe cases the temperature is high, there is great prostration, and excessive toxæmia. Death frequently results within a few days. Some of the common complications are emaciation and anæmia. The nursing care consists of maintaining plenty of fresh air, quiet, and cleanliness. Stools should be carefully observed and charted. Rectal irrigations frequently are prescribed, and in administering them great care and caution are necessary.

Cholera.—Caused by the *Spirillum cholerae asiaticæ*; incubation period is from 1 to 5 days. The disease is characterized by the following symptoms: Headache, malaise, diarrhœa, and colic. During the later stages or stage of collapse, excessive vomiting, purging, high temperature, cold and clammy shrunken and livid skin, rapid emaciation, intense thirst, severe muscular cramps, diminished secretion of urine, and rice-water stools (water and salts from the blood, and epithelium from the intestinal walls) are present. An increased temperature with a warm feeling of the body indicates the turning point, and recovery usually results. Failure of the heart action is the most common complication. The nursing care consists of isolation, absolute quiet, the application of external heat, and the administration of normal saline solution by hypodermoclysis.

Diseases transmitted by insects.

Malaria.—Caused by malarial parasites (protozoa); the tertian life cycle is 48 hours, ending on the third day; the quartan life cycle is 72 hours, ending on the fourth day; and the æstivo-autumnal life cycle varies from 36 to 72 hours. Malaria is transmitted by the anopheles mosquito (female) by biting, usually at dusk and at night. The incubation period is not definite, and the disease is characterized by a chill every 48 to 72 hours, sometimes occurring more often. The chill is coincident with the rupture of the red corpuscle containing the parasite, which has previously subdivided into numerous smaller forms (sporozoa).

During and after the chill the patient usually has a headache, is nauseated, the pulse is frequent and full, the temperature is very high (occasionally 107° F.), and is accompanied by profuse sweating. Severe cases of malaria may show typhoidal symptoms, while mild cases usually feel comparatively well between chills, the temperature, pulse, and respiration being normal. Some of the common complications are anæmia, congestion of the liver and kidneys, and bloody urine. The nursing care consists of noting and recording all chills, their duration, time of starting and ending, and their severity, varying from a slight chilly sensation to shaking of the entire bed. Temperature, pulse, and respiration should be taken every hour after a chill until they return to the previous temperature, pulse, and respiration. During a chill external heat should be applied and the patient surrounded with hot-water bottles and kept in bed. Plenty of easily digested, nutritious food should be given and the bowels and kidneys kept active. The prevention of malaria is taken up in the chapter on Preventive Medicine, Hygiene, and Sanitation.

Yellow fever.—Caused by the *Leptospira icteroides*, transmitted by a mosquito, the *Aedes ægypti*; incubation period is a few hours to five days, and the

disease is characterized by a chill, muscular pain, especially in the legs and back, jaundice of the skin and conjunctivæ, and vomiting (sometimes black vomitus or digested blood). The eyes become watery, glazed, and sunken; the temperature reaches 102° to 103° F. for two, three, or four days, when it drops to normal. At the end of 24 hours it rises to 102° F., then falls by crisis or lysis. The pulse rate is first 90 to 115 and later comparatively slow. Some of the common complications are suppression of urine and hæmorrhage from any part of the body. The nursing care consists of keeping the patient absolutely quiet. Hot applications, counterirritants, and light massage should be applied for muscular pain. All urine should be measured, its appearance noted and charted. The patient's bed should be covered with cotton netting.

Typhus.—*Cause* not definitely determined; is transmitted by the body louse; *incubation* period is 12 days; and the disease is characterized by a chill, headache, and delirium. The temperature is high during the first week, with a marked remission in the morning during the second week, and at the end of 13 to 14 days returns by crisis to normal. The *eruption* appears on the fourth day; at first as elevated rose spots or patches which later assume a dusky hue and lose elevation, appearing as ecchymotic areas under the epidermis. The nursing care consists of maintaining an abundant supply of pure, fresh air and the usual general fever nursing.

Diseases which may result from an abrasion of the skin or mucous membrane.

Tetanus.—*Caused* by the *Bacillus tetani*; the *incubation* period is one day to three weeks; and the disease is characterized by rigidity of muscles, beginning with the jaws and neck, and progressing until all except the arms are involved. Convulsions are caused by the slightest stimuli and vary in severity, sometimes reaching the extent that the body becomes arched so that the head and heels only touch the bed. The temperature varies from 103° to 105° F., and the pulse rate is about 110. The nursing care consists of maintaining absolute quiet, keeping the room dark, and general nursing care and prophylactic measures. It is frequently necessary to resort to nasal or rectal feedings.

Septicæmia.—*Caused* by a pus-forming organism; the *incubation* period is from two hours to two or three days; and the disease is characterized by chills, temperature of 102° to 105° F., nausea, headache, anorexia, and all the febrile symptoms. Cases of this disease often become typhoidal in type with or without delirium, the skin becoming cold, the body freely perspiring, marked cyanosis being present, and the face being pinched and drawn. Pyæmia is a common complication. The nursing care consists of maintaining plenty of fresh air, an abundance of nutritious food, and careful general nursing.

Erysipelas.—*Caused* by the *Streptococcus erysipelatis*; *incubation* period is from 24 to 72 hours; and the disease is characterized by a sudden onset with chill, nausea and vomiting, high temperature, and appearance of localized inflammation of the skin. The area of skin involved is red, swollen, and sharply limited, and sometimes is accompanied by severe pain. The nursing care consists of isolation, the administration of plenty of fluids, and rigid precautions against transmitting the infection to the surgical cases. It is imperative to use all prophylactic measures.

Diseases of the respiratory tract.

Acute bronchitis.—*Caused* by irritation and infection of the respiratory tract following exposure to wet and cold, and is characterized by the following symptoms: Sore throat, general malaise, constant cough with pain in the sternal region, and temperature of 101° to 103° F. during the first week.

Chronic bronchitis is the most common complication. The nursing care consists of maintaining plenty of fresh, moist, but warm air, and keeping the room free from drafts, steam inhalations, if ordered, and general nursing care.

Influenza.—Caused by the *Bacillus influenzae*; incubation period is from two to four days. The disease is characterized by a sudden onset with slight chill; intense aching of muscles (legs and back); coryza; frequently sore throat; and increase in temperature in mild cases to 100° to 102° F., in severe cases to 103° to 104° F., dropping by lysis to normal. Otitis media, sinusitis, bronchitis, pneumonia, and myocarditis are common complications. The nursing care consists of keeping the room warm and free from drafts and general nursing.

Pneumonia.—Caused by infection of the lungs by one of several organisms; incubation period is from 24 hours to 7 days; and the disease is characterized by the following symptoms: A chill, severe pain in the chest, temperature rises to 104° or 105° F., remaining high for from three to nine days, at which time it falls to normal or below in a few hours (crisis) or more slowly (lysis); the respirations are shallow, rapid (up to 60), and labored; and the pulse is full and bounding (96 to 120 to 140). During the first stage of the disease the sputum is a frothy, serous fluid mixed with mucus, and streaked with blood; during the second stage it becomes prune juice or brownish red in color, due to the presence of blood; and during the third stage it is abundant, shows evidence of less blood, which gradually disappears, the sputum gradually becoming less in quantity, until it returns to normal. Cyanosis, œdema of lungs, tympanites, circulatory failure, and pleurisy are the common complications. Empyæma, abscess of the lung, and gangrene of the lung may be the sequelæ. The nursing care consists of limiting all movements of the patient which require exertion, etc. Tenacious or sticky sputum should be carefully wiped from the lips with small pieces of gauze and placed in a paper bag to be burned later. The patient must be encouraged not to talk too much. Visitors should not be permitted except by the doctor's permission. Unfavorable symptoms, especially delirium, should be watched for. Maintain plenty of fresh air, keep the patient warm, and avoid drafts. A rectal tube having its free end in a pus basin may be inserted and hot fomentations applied to the abdomen to relieve discomfort in tympanites. The patient should not be permitted to sit up during convalescence until orders to that effect are issued by the medical officer in charge of the case.

Tuberculosis.—Caused by infection with the *Bacillus tuberculosis*, and characterized by the following symptoms: Loss of appetite, loss of weight, a short hacking cough with the production of more or less sputum, a moderate increase of temperature in the afternoon, a hectic flush, especially in the afternoon, and a soft and rapid pulse. Later in the disease there are usually emaciation, progressive weakness, and night sweats. The sputum contains the bacillus tuberculosis. The nursing care consists of keeping the patient out of doors and dressed warmly, giving an abundance of nutritious foods, and general nursing care.

Special diseases.

Diphtheria.—Caused by the *Bacillus diphtheriæ*, which produces a very virulent toxin. Incubation period is from 1 to 10 days. The disease is characterized by the following symptoms: General malaise, swelling of the glands of the neck, and soreness of the throat. At first the throat is red and slightly swollen; by the end of the first day a pale gray membrane appears on the tonsils, and may extend to the pillars, uvula, pharynx and soft palate. This mem-

brane is removed with difficulty and leaves a bleeding surface. The temperature is comparatively low, seldom rising above 103° F., lasts from 7 to 10 days, and falls by lysis. The pulse is rapid and in severe cases, weak, and irregular. Cardiac weakness is indicated when the pulse rate falls below 60, or increases above 120. The common complications are heart failure, acute nephritis, broncho-pneumonia, paralysis, especially of the muscles of the eyes, the pharynx, and the vagus nerve. The nursing care consists of spraying and irrigating the throat, giving plenty of nourishment and water, watching for regurgitation of food and water, and preventing all exertion and excitement. The patient should not be allowed to sit up too soon during convalescence, because of the danger of overtaxing the heart. Preventive measures are taken up in the chapter on Preventive Medicine, Hygiene, and Sanitation.

Follicular tonsillitis.—Caused by infection with the *Streptococcus* or *Staphylococcus pyogenes*; the incubation period is from 24 to 72 hours, and the disease is characterized by the following symptoms: Sore throat, the tonsils are red and swollen and covered, or partly covered, with yellowish white patches which are removed easily and leave no bleeding surface. The disease causes severe pain in the throat, and a temperature of about 103° F., which falls by lysis. Marked prostration is a prominent symptom and the disease is frequently complicated by suppurative tonsillitis, rheumatism, and acute endocarditis.

Suppurative tonsillitis is characterized by intense pain in the region of the throat, and the presence of exudate which covers the surface of the tonsils. Abscesses may form and discharge thick, fœtid pus. The nursing care consists of using gargles or sprays of astringent and antiseptic solutions; and applying ice caps or hot water bags to the throat. The diet consists of very hot or ice cold liquids.

Vincent's angina.—Caused by Vincent's spirochete (*Spirochæta vincenti*), associated with the fusiform bacillus. Incubation period is from 24 to 72 hours. Symptoms: Somewhat similar to tonsillitis. A gray fœtid exudate covers the ulcerated areas. The nursing care consists of isolation and general prophylactic measures.

Meningitis.—Caused by the meningococcus (*Diplococcus intracellularis meningitidis*). Incubation period is uncertain. The disease is characterized by the following symptoms: A sudden onset, chill, or convulsion, intense headache, projectile vomiting, photophobia, and strabismus. The temperature runs an irregular course; the muscles of the neck become rigid, the head is retracted, attempts to extend the thigh and leg meet with resistance, and the skin and muscles become very sensitive. Pneumonia, pleurisy, endocarditis, pericarditis, and otitis media are the common complications. Deafness, blindness, local or general paralysis, and mental derangement may be the sequelæ. The nursing care consists of maintaining absolute quiet; keeping the room cool and dark and at a temperature of 65° F., the practice of general prophylactic measures, and nasal feedings, if necessary.

Diseases which are not communicable but often are sequelæ of communicable diseases.

Acute endocarditis.—Caused by infection from various organisms; and characterized by the following symptoms: In mild cases there is usually dyspnoea on exertion, but the patient may have no subjective symptoms; in severe cases the pulse is rapid and the patient has marked palpitation of and a varying degree of pain in the heart, accompanying dyspnoea. The nursing care consists of maintaining absolute quiet, avoiding all excitement or worry, insisting upon

rest in bed, unless advised otherwise, providing plenty of fresh, warm air, and easily digested foods. An ice cap over the heart is often beneficial.

Rheumatic fever.—Caused by an organism, probably the *streptococcus rheumaticus*, and characterized by the following symptoms: Slight malaise, fever, sore throat, pain and tenderness in the affected joints, which become red and swollen (as swelling subsides in one joint, another joint usually becomes involved). The disease continues for several weeks, and relapses are frequent. The patient usually perspires profusely, and the temperature rises to 102° to 104° F., with marked remissions. The pulse is rapid and weak, and the urine scanty, highly colored, and acid in reaction. Common complications are endocarditis, myocarditis, pericarditis, tonsillitis, and anaemia. The nursing care consists of maintaining absolute quiet, sparing the patient from all exertion and excitement, observing great care in handling or moving, using bed cradles to relieve weight of bed clothes, and applying flannel bandages with or without oil of gaultheria dressings to the affected joints. During excessive perspiration the patient should be kept between light woolen blankets, and the room should be kept warm and free from draughts, but well ventilated. The throat and mouth should be kept clean, and alkaline water and proper diet administered.

Acute nephritis.—Caused by exposure to cold or by bacterial infection. It is characterized by the following symptoms which may vary somewhat: Eyelids puffy and oedematous, pallor, headache, and pain in back, nausea, vomiting, dizziness, chills, and usually some elevation in temperature. The urine is scanty and contains albumin. The nursing care consists of keeping up elimination through the bowels and skin by active catharsis, and the administration of hot baths and packs; the diet should contain no proteins, and in severe cases should be salt free. All urine should be measured and charted, and the room kept warm and free from draughts to avoid chilling the patient.

SURGICAL NURSING.

Preparation of patient for operation.—The details of the preparation of patients for operation differ somewhat in the various hospitals, but the general principles are the same. Five essential points which should be remembered are: The patient's skin should be clean, especially so at the site of operation; the stomach should be empty (the diet regulated prior to operation); the bowels should be empty (accomplished by giving a catharsis the night before followed by enemata the morning of operation); the bladder should be empty (the patient should void urine or be catheterized before going to the operating room); the patient's mouth should be examined for artificial teeth, and if any are found they should be removed.

To avoid tiring the patient on the day of operation, a bath should be given the day before, and the finger and toe nails carefully cleaned. If the patient is able to take his own bath it should be permitted, but an examination should be made afterwards to see that the bath has been satisfactory. Patients with an elevated temperature should be given a cleansing sponge bath.

Every patient should void urine before being taken to the operating room. If unable to do so, a report to this effect should be made to the operating-room staff, in order that the surgeon will know before operating and, if necessary, order the patient to be catheterized. Catheterization lessens the danger of an incision being made into the bladder during an abdominal operation. Specimens of urine should be sent to the laboratory the morning before and another the morning following an operation.

Except in cases of an emergency operation, the patient is given a cathartic the evening before the operation (one-half ounce of castor oil acts quickly and does not remove too much of the body fluids by purgation). The morning of the operation a soapsuds enema, which may be repeated if necessary, should be given. Not more than three enemas should be given, as more than that number tend to cause too much intestinal distention, with resulting lack of peristalsis after the operation.

Diet on the day before operation should be nutritious but light, and no solid food should be given within 12 hours before an operation. If the patient is weak and requires food, strained soup or broths may be given up to six hours before the operation, after which time nothing should be taken by mouth. The patient should be encouraged to drink water freely until eight hours before the operation. The less food a patient receives before an operation the better, as a rule, will be the recuperation after the anæsthesia.

Preparation for a mouth operation.—This preparation is the same as for any other operation, except that an antiseptic mouth wash should be used every 3 hours during the 24 hours preceding the operation. Each mouth wash should be followed by a nasal douche.

Rectal preparation.—Rectal preparation is the same as that for other operations, except that on the morning of operation, instead of a soapsuds enema, the patient is given a colonic flushing, which is continued until the return flow is clear.

By having the skin clean one source of infection is removed and the pores are open to throw off the toxins in the body resulting from the anæsthesia. In emptying the intestines and bladder the danger of accidental incision with the evacuation of contents into the abdominal cavity is removed. Having the stomach empty prevents the entrance into the trachea of solid substances, which might cause choking, and also helps to prevent post-operative nausea. The principal object to bear in mind is that the patient must not be tired by the severity of the preparation.

In preparing an acute abdominal case do not subject the patient to the slightest strain in lifting or moving, and if an enema is ordered, introduce the tube carefully, regulating the flow of water in such a manner that any sudden inflation of the bowel and rupture of a possible pus sack may be avoided. The hospital corpsman should see that the patient goes to the operating room in good spirits and not in a mentally depressed state; the anæsthetic will be taken more easily and recovery will be quicker.

Final preparations.—Shortly before the patient leaves the ward a clean cotton nightgown, open down the back, and flannel operating-room stockings should be put on; loose artificial teeth should be removed, if present, and the clinical chart should be written up indicating, especially, the time and the amount of urine voided.

Post-operative care during the first 24 hours.—After operation under general anæsthesia a patient usually remains in an unconscious condition for some time and the circulation is poor, due to the nervous depression from the anæsthetic. The patient really is in a state of shock and must receive especial care until reaction takes place and perfect consciousness of surroundings is recovered. The room or ward to which the patient is returned should be warm, with plenty of fresh air, but no draughts or glaring lights; the ether bed must be prepared with warm blankets; he must be carefully lifted from the stretcher to the bed, and the danger of injuring the arms avoided; he should not be left alone until he is fully conscious, and hot-water bags should not be left in the bed of an unconscious patient unless so ordered by the doctor. The

patient's pulse and respiration should be taken and recorded every 15 minutes, the tongue watched to avoid its falling back and choking the patient; and the hospital corpsman should press his fingers just below the angle of the jaw to force the lower jaw slightly forward. If the patient vomits, the head should be turned to one side. If a post-abdominal-operative patient retches severely, slight pressure toward the wound should be made with the hands to prevent tearing of the sutures.

Hospital corpsmen assigned to post-operative cases should avoid exposure of the patient (sudden change of temperature may cause pneumonia). Water should not be placed within the patient's reach until he is allowed to have it. Intense thirst may be relieved by wetting the lips with wet gauze or allowing the patient to rinse his mouth. When water is allowed it should be given in small quantities, either hot or cold—never lukewarm. If it is impossible for the patient to void urine within 10 hours after the operation the medical officer in charge should be notified, and, if he so directs, the patient should be catheterized. Frequent bathing of the hands and face is very comforting to the patient.

Nausea may be controlled by applying heat in the form of a hot-water bag or hot compress to the region of the stomach. Cracked ice, finely crushed and fed with a spoon, frequently relieves nausea. If persistent, a mustard plaster or hot stupes may be used or a gastric lavage given. These remedies are applied only when so directed by the medical officer.

Replenishing the system with fluid after operation.—Fluid may be introduced into the body by proctoclysis, enteroclysis, or by hypodermoclysis. The fluid usually administered is normal salt solution, and the reasons for this choice are: It stimulates the heart action, flushes the kidneys, provides the tissue cells with the fluid they require, and lessens the patient's thirst.

Urine.—A specimen of urine should be sent to the laboratory before and after an operation, and daily for several days afterwards, if there is any abnormality in the amount voided or in the character of the urine. Voiding or being catheterized within 10 hours after an operation lessens the danger of retention of urine and brings to notice suppression of the urine if it is present.

Subsequent post-operative care.—Usually the underlying factors in the post-operative condition are the depression of the nervous system by the anæsthetic, poor circulation, loss of muscle tone, and diminished oxidation. These factors constitute the main conditions of what is known as post-operative shock and subject the patient to numerous post-operative complications.

Distension of the intestines is due to lessened peristalsis, caused by lack of muscle tone, and causes an accumulation of gas to collect in the intestines, a condition which in abdominal cases may become very dangerous. Unless relieved, the intestines become very distended and paralyzed, thus preventing peristalsis. The distended intestines may push the diaphragm up against the heart and lungs and interfere with the functioning of these organs.

An operation causes diminished oxidation, which lessens the heat production in the body and results in a subnormal temperature which usually rises as a result of the reaction which follows. The condition of the respiratory tract predisposes the patient to pneumonia and that of the alimentary tract to nausea. The kidneys are irritated, partly by the action of the drug they are trying to eliminate and partly by the action of the substances they are trying to excrete. The acids which arise from the latter may poison the individual and induce a condition known as acidosis or autointoxication. Another abnormal condition is the lack of fluids in the body, due to purging before the

operation, the loss of blood during the operation, the inability to take fluids by mouth, and also to the effects of the anæsthetic.

The aim of after-treatment is to counteract the effects of the operation upon the system and to prevent the occurrence of complications which may arise, either as the result of the effect of the operation or because of the conditions for which the operation was performed.

In after-treatment the following symptoms should be noted: Evidence of severe pain in the region of operation (see if bandage is too tight and report at once); abdominal strain, which may be relieved by placing a pillow under the flexed knees; and pain in the small of the back, which may be due to position and length of time on the operating table, and which may be relieved by placing small pads or pillows under the affected parts. Flatulence or gas in the intestines can be relieved by introducing a well-lubricated rectal tube into the rectum for a distance of about 8 inches, or by a carminative enema, or by the application of turpentine stupes to the abdomen. These treatments must be ordered by the medical officer. Change in color or increasing pallor is a sign of hæmorrhage; pallor with a pinched expression is a sign of shock or collapse; cyanosed or bluish hue is a sign of cardiac or respiratory complication; and rapid or difficult breathing may be a sign of congestion of the lungs. All of these symptoms should be reported at once and the patient should not be left alone.

Diet in post-operative care is of the utmost importance. Never give a diet other than that ordered by the medical officer. Usually for the first 6 to 12 hours after operation, water only should be given unless specially ordered; the second day, liquids without milk; and the third day, liquids with milk. The third night, if the operation was not a rectal one, the patient usually is given a mild cathartic, after which he may receive a soft diet, and finally graduate to a full diet. After a hæmorrhoid operation the patient usually is kept on a liquid diet for a number of days to avoid a residue accumulating in the intestines which would cause a bowel movement, expel the packing, and possibly result in a hæmorrhage. If, as is sometimes the case, a patient has persistent nausea for days after the operation, great care should be observed regarding the diet. It should be liquid in form, but as concentrated as possible and administered frequently in very small amounts. It may be necessary to give partially digested foods, such as peptonized milk, etc. Articles of food which the patient especially likes, provided they are digestible, are often more likely to be retained.

The treatment of abdominal operations when infection has been present is important. The patient should be kept quiet so that localized septic matter will not be scattered throughout the abdominal cavity; the system must be flushed with fluid (enteroclysis), and if the patient is able to drink, water should be forced and all the nourishment possible should be given. For abdominal drainage the patient should be placed in Fowler's position, in which the patient is placed in a semisitting posture at an angle of 45°, supported by pillows or a back rest, the buttocks resting against the pillows, which may be secured to the bed by bandages to prevent slipping. In this position pillows should be placed under the knees and elbows. In most hospitals Gatch frames which can be adjusted so that the patient will be held in this position without additional pillows are used on the beds.

In surgical nursing baths are as important as in medical nursing, in that they keep the pores of the skin open and help rid the system of its contained toxins. The back should be kept clean and dry. No wrinkles in the clothing

(personal or bed) of the patient should be permitted, as a septic condition predisposes to bedsores.

Enemata are fluid injections into the lower bowel by way of the rectum. They are given to wash out the intestines, to provide stimulation, or to supply food to the patient. In administering enemata the patient should lie either on the left side or flat upon the back with the knees flexed, and all necessary articles should be at hand before administration. An enema may be given "low" by passing the tube into the rectum for a distance of 3 or 4 inches only, or "high" by passing the tube a distance of from 8 to 10 inches into the rectum.

The following instructions should be observed when giving an enema: Have the nozzle well lubricated and avoid injecting air or chilled fluid. To do this the tube should be filled with fluid, which should be allowed to escape until that in the tube is at the required temperature. Then clamp the tube to retain the fluid while the rectal tip is being inserted gently upward, backward, and toward the left. The part of the tube in the rectum should not be moved about, and the enema should be administered slowly, pausing frequently to avoid causing peristalsis. When the enema has been completed the tube should be withdrawn gently and the tube pinched to avoid spilling any of the remaining fluid. If a funnel is used in place of an enema can, care should be taken to replenish the fluid before the funnel is empty, thus preventing air from being admitted to the intestines.

There are several kinds of enemata. For example, an anthelmintic enema is given to destroy worms; an antiseptic enema to destroy bacteria; an astringent enema to contract the tissues and superficial capillaries and is used both in cases of hæmorrhage and in certain forms of diarrhœa; a carminative enema to relieve flatulence usually is given with or before a soapsuds enema and the patient encouraged to retain it for half an hour; and an emollient enema to soothe irritation of the mucous membrane of the intestines, thereby checking diarrhœa (starch of a creamy consistency usually being used, at a temperature of 103° F., and administered through a catheter). Nutrient enemata are given for the purpose of supplying nourishment to patients when they either can not or will not take food by mouth. The food administered in this manner must be partially digested, as the digestive juices are not present in the large intestines. Some of the ingredients used are peptonized beef extract or peptonized milk with egg, the amount never being more than 6 ounces, at a temperature not exceeding 100° F.; otherwise the digestive process will not be continued after the material enters the intestines. A soapsuds enema always should be given one-half hour before a nutrient enema, except when nutrient enemata are ordered continuously, in which case the soapsuds enema is given once a day before the first nutrient one. Purgative or cleansing enemata are given when immediate action is required, when nausea or other ill effects are feared from catharsis by mouth, when a thorough cleansing of the intestines is required, or when the action of catharsis is to be furthered by emptying the bowel. From 1 to 4 pints of soapsuds solution is used (castile or any bland soap always should be used, never an irritating soap which might injure the mucous lining of the intestines), at a temperature of 105° F., and the patient should be encouraged to retain it from 5 to 15 minutes to effect a good result. Sedative enemata, usually containing chloral or bromide, are given as a local or general sedative. Stimulating enemata are given for general stimulation and may contain whisky, brandy, coffee, or normal saline solution, and usually are preceded by a soapsuds enema. They are given slowly, high, at a temperature of 110° F., and must be retained. A saline enema may be given to supply the tissues with fluid and to relieve thirst. The temperature should be 110° F., and it should

be given high and slowly in amounts of from 8 to 10 ounces, which must be retained to allow absorption.

When a high oil enema is ordered, olive oil and glycerin in amounts of 6 to 8 ounces at a temperature of 90° F. usually are used. This enema must be given high and slowly and followed in from two to four hours by a soapsuds enema.

A rectal suppository should be lubricated with oil and passed as far into the passage as the finger will permit: the patient should lie on his left side; and the finger should be protected with a rubber cot, also lubricated.

Enteroclysis, sometimes called intestinal irrigation or colonic flushing, differs from an enema in two ways. In the first place, more fluid is used, usually 2 to 6 gallons of normal saline or sodium bicarbonate solution, and, second, means are provided for the immediate removal of the fluid by inserting two colon tubes, one for the inflow inserted about 8 or 10 inches and the other for the outflow or siphoning off, which is inserted for a distance of about 3 inches. The purpose of enteroclysis is to flush out the intestines, to stimulate the kidneys, and often to rid the body of toxins.

In giving enteroclysis the patient should be brought to the very edge of the bed, in the same position as for an enema, covered with a blanket, the bed-clothes drawn down and an operating pad placed under the patient in such a manner that it will drain into a bucket at the side of the bed. The irrigating can should be filled from one of the pitchers containing the solution at a temperature of 110° F., air being let out of the tube by allowing water to run through until the proper temperature is obtained. The end of the tube is lubricated and inserted gently from 8 to 10 inches into the rectum. The second tube for outflow should be lubricated at the rectal end and inserted for a distance of 3 inches. The return flow should begin almost immediately after the inflow has been started and should drain into the bucket at the side of the bed. The inflow should be continuous until all of the fluid has been used or until the return is absolutely clear. Air should not be allowed to enter the tube when refilling the can and may be prevented by adding more of the solution before the can is entirely empty. It is best to precede this treatment with a cleansing enema to avoid difficulty from possible impaction of feces in the return tube. The returned fluid should be examined and carefully noted as to whether it is clear, discolored, or contains mucus either in the form of specks, flakes, or stringy particles. If the patient becomes exhausted during the treatment, it should be discontinued immediately. The irrigating can should not be more than 2 or 3 feet above the pelvis of the patient, thus preventing the flow from becoming too great to obtain perfect siphonage.

Proctoclysis, sometimes called the *Murphy drip*, is a slow infusion, usually of normal salt or glucose solution, into the intestines by way of the rectum. (Fig. 97.) It is intended that the solution be entirely absorbed. For this reason the apparatus used is so arranged that the fluid enters the rectum drop by drop at the rate of 40 drops to the minute. The purpose of proctoclysis is to supply the system with fluid after hæmorrhage, shock, or diarrhœa, or when water can not be taken by mouth.

When giving proctoclysis the patient should lie on the left side or back, with knees flexed; air should be expelled from the tube by allowing the solution to run until it is of the required temperature, at which time the flow should be regulated by adjustment of the drop attachment. The rectal end of the tube (which should be a medium-sized catheter, not a colon tube) should be lubricated and inserted 8 to 10 inches into the rectum, and fastened to the bed by means of a safety pin or adhesive plaster. A thermometer

should be used to indicate the heat of the solution in the irrigating can, about which hot-water bottles should be applied and blankets wrapped, in order to maintain the required temperature of the solution. If a standard proctoclysis outfit is used the heat of the solution is regulated when passing through the saline heater or a thermos hot-water bottle, which is a part of the equipment. When ordered to give proctoclysis for "two hours on, and off for half an hour," it is not necessary to remove the tube for the half hour unless it annoys the patient. When the system has been supplied with a sufficient

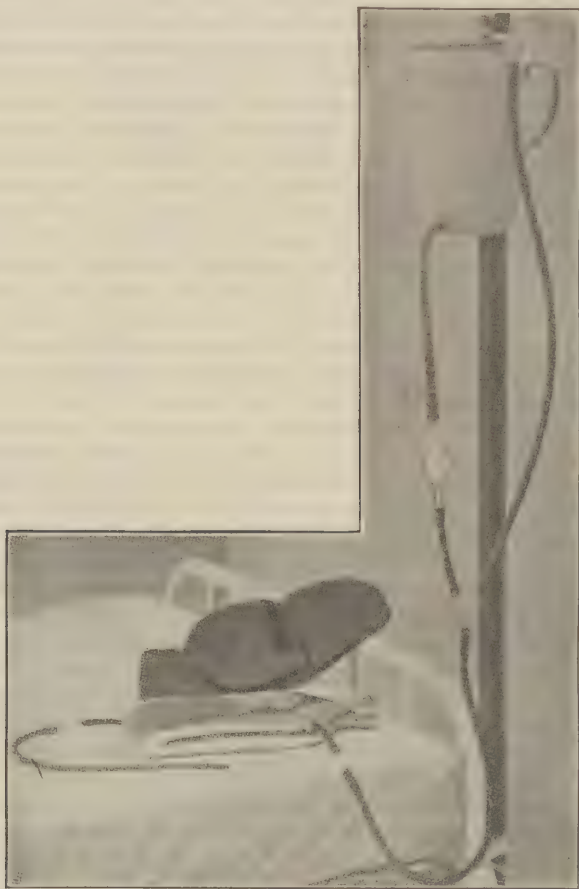


FIG. 97.—Apparatus for continuous proctoclysis (Murphy drip). (Warnshuis.)

amount of fluid this fact will be indicated by the patient's inability to retain the solution.

Hypodermoclysis is an infusion into the subcutaneous tissues, administered by the doctor only, and is used chiefly as a substitute for proctoclysis when for any reason it is inadvisable to inject fluid into the rectum or when immediate absorption is required.

In the preparation for hypodermoclysis it is imperative to keep all materials, apparatus, and solutions used absolutely sterile during the procedure. The site of the injection should be sterilized by painting with iodine and draped with sterile field cloths. It is advisable at times to inject a solution

of cocaine at the site where needles are to be inserted. The solution should be given very slowly, and the assisting hospital corpsman, with sterile hands, should gently massage the surrounding tissues to further absorption. Five hundred to 1,000 cubic centimeters of solution may be given in this manner, but care must be taken to avoid admitting air into the tissues and against allowing the fluid to accumulate and cause pressure on the nerve endings.

Catheterization is the emptying of the bladder of its contents by means of a tubular surgical instrument. (Fig. 98.) A soft rubber catheter, previously rendered sterile, should be used when practicable. Strict aseptic precautions must be observed to avoid infecting the bladder. The catheter, lubricated with sterilized oil, should be gently inserted into the urethra and passed in carefully until the urine begins to flow. When the bladder is empty the catheter should be removed carefully and a compress applied to the urethral exit to prevent the escape of the remaining urine. Improper care, by introducing bacteria into the bladder or injuring the mucous membrane lining, may give rise to an inflammatory condition which is usually very difficult to cure; therefore it is important that the strictest asepsis be maintained in preparing for, and during the procedure of, catheterization. The person who is to insert the catheter must have surgically clean hands, should observe that the end of the catheter to be inserted does not come in contact with anything un-

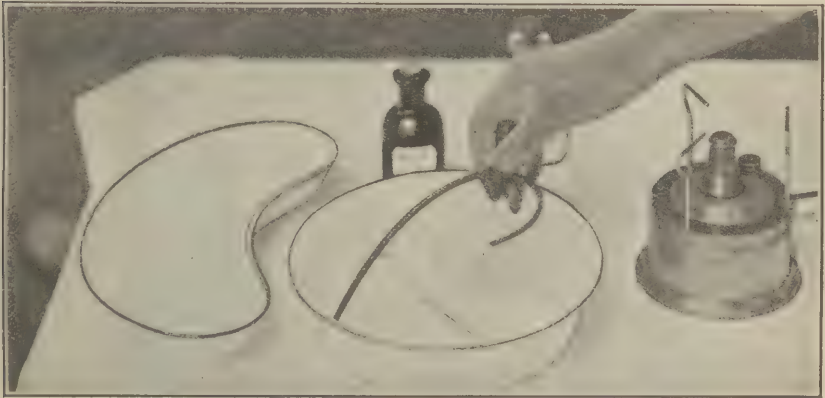


FIG. 98.—Tray for catheterization. (Warnshuis.)

sterile, and should see that the glans has been cleansed with an antiseptic. Force should not be used when inserting the catheter. If the bladder is greatly distended, not more than 600 cubic centimeters of urine should be withdrawn at a time in order to prevent a sudden collapse of that organ. The urine should be measured, and the amount obtained recorded on the patient's chart, together with the time of catheterization.

Expedients that should be tried to cause voluntary micturition before catheterization is resorted to are: Placing the patient on a bedpan and pouring warm water over the pubis; applying hot compresses or a hot-water bag to the pubis; if the patient is near a bathroom, allow water to run from a faucet, in order that he may hear the sound of running water; give plenty of liquids to drink, if allowed, especially vichy, mineral waters, and lemonade; and with the doctor's permission only, allow the patient to sit up, with support. This latter procedure must not be permitted without the doctor's consent.

Bladder irrigation is the process of washing out the bladder with 1 to 2 pints of a sterile solution having a temperature of 100° to 110° F. The procedure is

the same as that employed for catheterization, except that instead of removing the catheter when the fluid has been withdrawn the irrigator tubing, from which the air has been expelled, is attached to the catheter, the clamp opened, and from one-half a pint to three-quarters of a pint of the irrigation solution allowed to run slowly into the bladder. The flow should be checked when the bladder becomes full, the tubing disconnected, and the bladder allowed to drain; when the bladder is empty the tubing should be reconnected and the process repeated until the returning solution is clear or the desired amount has been given. If a funnel is used, about 8 ounces of the solution should be injected and half of the quantity siphoned off, repeating the injection with 4 or 5 ounces of the solution until the bladder is sufficiently irrigated. **Introduction**



FIG. 99.—Gastric lavage. (Warnshuls.)

of air should be carefully guarded against. With the use of a double or return flow catheter about one-half pint may be injected at a time.

Lavage is the process of irrigating the stomach, and frequently is used to remove poisons or irritating material (fig. 99) which may be causing nausea and for cleansing purposes.

For administering a gastric lavage the following articles should be at hand: A stomach tube in a basin of ice; a funnel to insert into the open end of the tube; a pitcher containing the solution to be used (usually sodium bicarbonate 5 per cent or boric acid 2 per cent at a temperature of 105° F.); a rubber apron or sheet, to protect the patient and bedding; a pus basin (in case the patient vomits); a small roll of bandage or a cork to place between the teeth in case of resistance; a bucket to receive the contents of the stomach; and a rubber sheet to protect the floor.

Before starting the treatment the patient should be reassured and instructed to breathe naturally and to make motions of swallowing while the tube is forced gently down the œsophagus. The patient should be in bed or seated in a low chair, the tube moistened in ice water and placed far back on the tongue, care being taken to direct the tube over the epiglottis into the œsophagus (the patient assisting by swallowing as the tube is inserted for a distance of 18 to 20 inches). The funnel is held a foot higher than the patient's mouth and from one-half to 1 pint of water allowed to flow into the stomach, then the funnel is lowered and the contents are siphoned off. This procedure is repeated until the water returns clear. If blood appears, the treatment should be discontinued at once and the medical officer notified. The tube should be pinched when removing, and removed quickly, to prevent draining the contents of the tube into the stomach and to prevent nausea. The character of the return, a statement showing the amount of liquid used before it returned clear, and a description of the contents, whether mucous or containing other foreign substances, should be recorded on the patient's clinical notes.

Gavage is the introduction of food into the stomach by means of a stomach tube. It is used when a patient will not or can not take food in the usual way. The following articles are necessary in giving a gastric gavage: Food, stomach tube in basin of ice, and a funnel to insert in the open end of the tube. The procedure for gavage is the same as that used for lavage, except that a few seconds are allowed to elapse after passage of the tube in order that the patient's muscular contractions may be quieted. The liquid, usually milk, broth, or eggnog, should be poured slowly and the tube removed quickly.

Nasal gavage or nasal feeding is resorted to when a patient is unmanageable or following operations upon the mouth or throat. The articles necessary for this treatment are the same as for gavage, except that a catheter is used instead of the stomach tube, and the catheter is lubricated with glycerin instead of being moistened with ice water. Special precautions necessary in nasal feeding are: To make sure the tube has not entered the trachea and to use no force during insertion. If there is any obstruction in the nostril, remove the tube and insert it in the other side, as there may be a curve in the septum of the nose on the obstructed side.

SURGICAL DRESSINGS.

Before taking up the methods of dressing wounds it is necessary to know important facts relating to the nature and healing of wounds and the conditions which may interfere with healing. (Refer to the chapter on First Aid and Minor Surgery for classification of wounds and the manner in which wounds are healed.)

Points to remember when preparing for and when dressing wounds.—Always dress aseptic wounds before dressing suppurating wounds. Absolute asepsis must be maintained. Moisten adhesive plaster and adherent gauze before attempting to remove. Pull adhesive strips toward the wound on both sides and pull quickly to avoid causing pain. Use sterile forceps to remove dressings from a wound and to hold the sponges which are used for wiping discharges from the skin; never use the same pair of forceps for handling sterile supplies. When washing the skin around the wound always wipe away from the wound. Do not touch with the fingers anything that can be handled with a pair of forceps, even when wearing gloves. Do not squeeze a suppurating wound nor any localized collection of pus; doing so may force

the infection through the adjacent tissue; Bier's cups should be used, or Carrel-Dakin treatment instituted. If told to irrigate a wound with hydrogen peroxide, irrigate thoroughly afterward with saline or boric acid solution to remove all decomposed material. Remove discharge and sloughs with forceps or by means of irrigation, not by rubbing with a sponge. When a caustic, such as silver nitrate, is used after irrigation, first dry the area with gauze to prevent the spread of the caustic. When using a caustic, touch only the granulations that need the treatment. When packing a wound with gauze do not rub it or pack the gauze down tightly; it should be loose and fluffy, otherwise it will not absorb the secretions and will interfere with drainage. When discharge irritates the skin the skin should be covered with vaseline gauze. Always note and report any abnormal conditions in a wound. Always reinforce a dressing as soon as discharge appears at the surface; soiled dressings look unsightly and are a breeding place for bacteria. If more than one dressing is to be done, rinse the hands with alcohol or a disinfectant solution before and after each dressing. Use sterile forceps to remove sterile material from a sterile jar; in removing the cover, invert it in order to prevent anything touching the inside. When pouring a sterile solution from a bottle always wipe the rim of the bottle first with sterile gauze.

Kinds of dressings.—Wet dressings, to be effectual, should be kept wet by moistening every three hours. They should be covered with oiled silk or waxed paper in order that they may retain moisture and remain sterile and that the bedclothes may be protected. A dry dressing is usually a dry sterile pad fastened with adhesive or a bandage.

Procedure in applying a dressing.—The hands must be scrubbed with tincture of green soap and water for 10 minutes before any dressings are started. Remove the soiled dressing with a pair of forceps; sponge the wound with dry sterile sponges or wipes, or ones dipped in alcohol or an antiseptic solution; be careful not to go over the same area more than once, using only one motion with firm but gentle pressure. The used sponge being discarded, another is taken to wipe around the outside of the wound (wiping away from the wound); apply the sterile dressing with forceps and strap with adhesive. Rinse the hands with alcohol or a disinfectant solution before starting another dressing.

Dressing tray.—When only one dressing is to be done, the dressing tray usually contains instruments sterile (tissue forceps, hæmostat, probe, scissors, and a scalpel if needed); sterile sponges and dressings; bandages and cotton if necessary; and two cups or containers with alcohol in one and the solution preferred by the surgeon in the other. When two or more dressings are to be done, it is necessary to place more instruments and supplies on the tray. The tray should be covered with a sterile field cloth, on which sterile things are laid, and covered with another sterile cloth whenever the tray is not in actual use.

To remove skin sutures.—Take the suture on one side of the knot with the forceps, cut it on the other side as close to the skin as possible, and then draw it gently backward and outward. Some surgeons have the suture holes painted with a weak solution of iodine and others cover them with collodion, while some prefer a compress wet with alcohol placed over the wound for a few minutes before applying a dry sterile dressing. A dry dressing is usually a folded compress (large or small) secured in place by adhesive plaster, bandage, or binder. Clean wounds are not dressed as frequently as infected wounds; the latter are dressed at least once a day and sometimes more often, according to the amount of drainage.

All dressing performed by hospital corpsmen must be in accordance with instructions received from medical officers having charge of the cases.

BATHS.

A bath is any yielding medium such as water, vapor, mud, or sand in which the body is wholly or partly immersed for conservation or restoration of the health.

Baths are classified in regard to temperature or extent. A general bath is either a tub or a sponge bath; a local bath may be a sitz, pelvic, or foot bath.

The baths most frequently used in routine nursing are for cleansing purposes, to reduce temperature, and to induce perspiration.

Baths are given for the following purposes: (1) Cleansing; (2) for general stimulation; (3) to induce perspiration; (4) for reduction of temperature or inflammation; (5) as a nerve tonic or sedative; (6) as a counterirritant; and (7) medicated baths, in specific cases, either for the local effect on the skin or for their general action upon the system.

Depending upon their temperature, baths are known as *tepid*, 85° to 92° F. (sedative); *hot*, 100° to 110° F. (depressant); *cold*, 60° to 70° F. (stimulant).

A cleansing bath is important because the skin serves the body not only as a covering but also as an excretory organ, being in this respect very important. The skin performs this function through the agency of the sweat glands, and if these glands become clogged the work of the skin is hindered. This condition must be prevented, particularly during an illness when the waste products of the body are especially injurious, and during which time their presence in the system increases the danger of bedsores, boils, small abscesses, and a general toxic state. The sweat glands can be clogged quite as readily by the secretions which they are trying to eliminate as by anything from without. It is a mistake to assume that a patient in bed who does not appear dirty does not require a bath. *Baths should be given at least three times a week.* The ideal times for a bath are in the morning, before retiring, or one hour after meals.

The bath upon admission of a patient may be given in bed or in the tub, according to the temperature of the patient, his condition, and the character of his disease or injury.

Bed bath.—In preparing for a bed bath (1) close the windows, have the room warm and devoid of draughts; and (2) bring everything required to the bedside. Two large bath blankets, two towels (face and bath), hot-water bag, soap, and nailbrush, a foot tub half filled with water at 110° F., and a pitcher of hot water with which to keep the bath at the required temperature are required.

When giving the bath draw the patient to one side of the bed, place a folded blanket over the chest; turn down the bedclothes, at the same time unfolding the blanket over the patient. Place a second blanket under patient and take off the pajama suit. Then proceed with the bath, washing, in order, the face, ears, neck, chest, arms, and abdomen (warm water is essential for this part); then gently turn the patient and wash the back, legs, and feet. In washing exert a firm but gentle pressure, and dry each part immediately after the washing of it has been completed. When washing the feet it is advisable to put them in the tub. Give the patient an alcohol rub at the end of the bath. The alcohol evaporates rapidly and will further the drying process, as well as harden the outer layer of the skin and lessen the danger

of the development of bedsores. Never expose the patient: the whole bath can be given under the blanket. The bath must not be considered complete until the finger and toe nails have been examined, cleansed, and pared.

When and how to give a tub bath.—As a general rule a patient may be given a tub bath if his pulse is fairly strong and regular, temperature normal, and general condition good. Fill the bath tub full of water at 100° F., and see that towels, wash cloths, and soap are at hand. Even when patients are well and able to take their own baths, they must not be allowed to lock the bathroom door, nor be left alone for any appreciable length of time.

In case of collapse, the bath must be discontinued at once; apply heat (blankets and hot-water bags); give hot drinks; keep the patient at rest and administer the stimulants ordered by the doctor.

Application of cold.—The principal purposes of application of cold are: (1) Stimulation of the vital processes, circulation, respiration, etc.; (2) relief of congestion; (3) stimulation and quieting of the nervous system; (4) reduction of temperature. (See section on Physiotherapy, subsection Hydrotherapy.)

The primary effect of cold is the contraction of the superficial blood vessels, thus driving the blood from the surface to the interior of the body.

The following rules should be observed in the administration of cold baths: A cold compress or ice cap should be applied to the head to prevent an increased flow of blood to that part of the body; a hot-water bag should be placed at the feet, as this tends to prevent chill or rigor, conditions which are evidence of muscular contraction and a too decided difference between the temperature of the central and the peripheral portions of the body. Continuous light friction is given for the same reason. Stimulants should be administered 15 or 20 minutes before the bath to prevent chilling and to help counteract any undesirable effect from immersion; hot drinks should be given after the bath, and blankets should be left on until reaction takes place.

Baths for high temperature usually are given every three or four hours while the temperature is 103° F. or over. The temperatures of baths vary from 65° to 95° F., and the duration also varies (10 to 20 minutes being the average). The temperature, pulse, and respiration always should be taken one hour after the bath and charted with dotted line to indicate the drop or rise.

Method of giving cold pack.—Protect the bed with a rubber sheet; wrap a wet sheet around the patient in such manner that no two surfaces of skin come together; apply a binder to the loins; keep the sheet wet by squeezing water of the required temperature over it; rub the surface of the sheet briskly; apply an ice cap to the patient's head and a hot-water bag to his feet. The duration of the pack should be 15 minutes.

In giving a cold pack *when the patient is not to be turned*, the following apparatus and materials are essential: A large basin or foot tub containing water at the temperature prescribed (usually 68° to 75° F.); three bath towels; several cotton or linen towels, the number depending upon their size (usually seven or eight); a bath thermometer; a basin containing a few small pieces of ice; an ice cap or compress; a hot-water bag; and a binder for the loins.

Remove all top covers except the sheet; pass the binder around the pelvis; protect the bed by placing a bath towel on either side of the patient and one over the legs; wring the towels fairly dry and place them around the arms and legs and over the chest and abdomen; remove the top sheet; have an extra towel in the water with which to start changing those on the body, and change them in turn at the rate of one every minute, rubbing the towels covering the body between changes. Dry the body by rubbing with a dry towel; cover with

a blanket; apply a hot-water bag to the feet; draw up the bedclothes and administer a hot drink of either broth or beef tea.

The principal purposes for hot baths and packs are (1) to induce perspiration and (2) to relieve muscular tension.

The articles necessary for giving *hot packs* are: An ice cap, four blankets, one towel, a foot tub lined with a rubber sheet in which to carry blankets wrung out of very hot water, five hot-water bags, pitchers of hot and cool water, a glass and drinking tube, and a large rubber sheet.

Soak two blankets in water at 150° F., leaving one corner of the upper and lower edge of each blanket out of the water (these corners should be diagonally opposite each other, as the blanket will then, when stretched, be somewhat on the bias); wring each blanket separately (two hospital corpsmen are required, each taking a dry corner and twisting in opposite directions until the blanket has been wrung dry. It then should be placed in the foot tub lined with a rubber sheet covering hot-water bags, and the process repeated with the second blanket); carry the blankets to the bedside while the rubber sheet is still folded over them; pass two dry blankets with rubber sheet between under the patient; remove the pajama suit; wrap the patient in the dry blanket upon which he is lying; and turn the upper bedclothes over the foot of the bed. Place one hot blanket under the patient and one over him; fold the rubber sheet over the wet blankets; pull up the bedclothes, placing a towel around the patient's neck; apply an ice cap to the head and hot-water bags to the hips, arms, and feet. Watch the patient's pulse and encourage him to drink freely, unless directed to the contrary. The usual duration of this pack is 20 minutes.

During and after removing a hot pack take the pulse at the temporal artery frequently; give plenty of fluids while the patient is in the pack; watch for collapse, in which case discontinue the pack and apply external heat; remove the wet blankets under cover of a dry one, thus avoiding exposure; wrap the patient in a dry blanket and leave an ice cap applied to the head and a hot-water bag to feet. Draw up the bedclothes and let the patient remain between blankets for one hour, at the expiration of which time dry the patient and give him an alcohol rub.

Foot baths are used for the relief of congestion either in the feet or in some other part of the body, as the throat, abdomen, or chest. Sometimes mustard is added in the proportion of two tablespoonfuls to the gallon of water.

To give a foot bath in bed the articles required are a foot tub half full of water at 108° to 112° F., a large blanket, a small towel, and a pitcher containing water at 130° F.

Loosen the upper bedcovers at the foot of the bed and double them back to expose the feet and legs to the knees; gently lift the legs and arrange a rubber sheet, covered with a bath towel, on the bed under the feet; place the foot tub on the bed alongside of the feet and place a folded hand towel over the edge of the foot tub upon which the legs will rest when in the tub. Next put the arm nearest the foot of the bed across the tub and place the other arm, the hand of which supports the heels, under the patient's legs; raise the feet from the bed and at the same time draw the tub into position; place the patient's feet gradually into the tub, lowering and lifting them into and out of the water several times until he becomes accustomed to the temperature, keeping the free arm across the tub during this procedure. A folded blanket then may be wrapped around the tub and the bedclothes drawn down. The feet usually are left in the water for 20 or 30 minutes, and the water maintained at the required temperature by adding water from the pitcher. During this process place the hand between the stream of water and the patient's feet

to guard against injury. In removing the feet put one arm and hand under the patient's legs and heels; lift the feet from the tub; hold them above it for a few seconds in order that the excess water may drain off; place them on a bath towel; remove the tub from the bed; and dry the feet and legs thoroughly. Gently remove the rubber sheet and towel and replace the bedcovers.

Sitz bath.—In this type of bath the thighs and trunk up to the waist line only are immersed; the temperature of the water is 110° to 112° F.; and the duration is from 5 to 10 minutes.

Salt glow.—Prepare two large pads of gauze by dipping them in a saturated solution of common salt and allowing them to dry thoroughly before using. Rub the patient with the pads, using gentle vigor until the whole body shows a pink warm glow, and follow with a warm bath.

In a busy ward it is often necessary to give baths at other times than have been mentioned as the ideal times. However, a bath never should be given within a period of less than one hour after a meal. This delay is necessary because a bath stimulates the blood vessels of the skin, and filling them, takes blood from the stomach and intestines at a time when it is needed for the process of digestion.

Care to be exercised in treatment baths.—No two skin surfaces should be permitted to come together during either a hot or cold pack; watch for collapse during the process; protect the bed; avoid pressure upon the abdomen; avoid too much turning of a very ill patient; heat should be applied after a bath; screen the bed; prevent draughts; have the room warm before giving the bath.

Medicated baths.—Bran, starch, bicarbonate of soda, and sulphur baths are used in the treatment of skin diseases. Mustard, Nauheim, and salt baths are used to produce counterirritation, improve the cutaneous circulation, and thereby relieve congestion of the viscera and for other abnormal conditions.

For medicated baths the trunk and extremities should be covered with water. This requires the tub to be between half and three-quarters full; an ordinary sized tub when half full contains 25 gallons or 100 quarts.

Bran bath.—Boil $1\frac{1}{2}$ pounds of bran in a bag for 20 minutes, drain off the fluid and add it to the bath water, which should be at a temperature of about 95° F.

Bicarbonate of soda bath.—This bath is used to allay itching of the skin. It is prepared by dissolving in the bath 8 ounces of bicarbonate of soda to each gallon of water used.

Starch bath.—Mix one-half pound of starch with sufficient cold water to cover it and add slowly sufficient hot water to make a paste of about the consistency of a thick cream; pour this into the bath water and mix thoroughly with the hands.

Sulphur bath.—Dissolve sulphurated potash in a small quantity of hot water and add this to the bath water. From 1 to 2 ounces of sulphur usually are used for this bath, and the temperature should be between 85° and 95° F.

In medicated baths the patient lies quietly in the bath for 10 to 20 minutes and then is removed and enveloped in a warm sheet and dried gently by patting over the sheet. These baths are given largely for their soothing effect upon the irritated skin; rubbing will counteract the benefit of the bath and should not be practiced.

The application of light and heat for therapeutic purposes is fully taken up in the section on Physiotherapy.

Bed or pressure sores.

The predisposing causes of these conditions are lowered vitality, extreme emaciation, and general œdema; the immediate causes are moisture, crumbs,

wrinkles in the bedclothing, pressure or position, and sometimes improperly applied appliances.

The preventive measures consist of bathing the pressure points with soap and water, frequent light massage, rubbing the parts with alcohol, powdering, and relieving pressure. Soap and water prevent clogging of the ducts in the skin, massage improves the local circulation, alcohol hardens the skin, powder absorbs moisture, and pressure is relieved by the use of an air ring, air cushion, pad, frequent change of position, and readjustment of dressings or appliances.

Douches and irrigations.

A douche is a local bath of running water used for the purpose of cleansing a cavity, to apply heat or cold to inflamed surfaces, to arrest local hemorrhage, and to apply medical treatment.

Nasal irrigation.—In administering nasal irrigations the stream should be of small caliber and under slight pressure. The patient should lean forward with his chin depressed and mouth open, and should breathe through the mouth. The great danger attending a nasal irrigation is infection of the middle ear, caused by forcing some of the discharge into the Eustachian tube. The following is a list of the articles required for this treatment: (1) A small irrigator with 12 inches or more of rubber tubing attached; (2) nasal tips attached to the distal end of the rubber tube; (3) a basin in which the used solution may be collected; (4) a towel; (5) a piece of gauze to be used as a handkerchief; and (6) the desired solution (usually normal salt solution, 1 to 500, at a temperature of 108° F.). Place the solution in the irrigator, properly connected with the tube and nasal attachment; hang the irrigator in such a position that it will be 2 or 3 inches higher than the patient's nose; allow the solution to flow through the tube until the air contained therein has been expelled, at which time the flow is checked by pressure of the thumb and index finger. Insert the nasal tip in one nostril and permit the solution to flow into that nostril and escape through the one on the opposite side, thus washing out the nasal cavity. If either one or the other side of the nasal cavity is obstructed, the solution should be allowed to flow into that side until the obstruction has been removed, care being taken not to cause too great a pressure. Irrigation should be discontinued immediately if the patient begins to cough or choke.

Pharyngeal douche.—The chief purposes of this douche are to prepare for an operation on the interior of the throat and as a cleansing agent in suppurative conditions of the throat. The following appliances are necessary: (1) An irrigator; (2) a piece of rubber tubing 2 to 4 feet long with a clamp attached; (3) a tip (a curved drinking tube often is used); (4) a tongue depressor; (5) a rubber dressing sheet; (6) a dressing towel; (7) a basin; and (8) 1 quart of normal salt solution, temperature 100° F., or a specially ordered solution. In administering this treatment it is advisable to cover the rubber sheet with a dressing towel and place it about the patient's neck for the protection of the bed and patient's clothing. The irrigator should be filled with the required solution and placed in such a position that it is 3 feet above the patient's head, which should be bent forward to prevent the discharge, if present, from being washed down the patient's throat. The basin should be so placed that it collects the used solution which flows from the mouth. The patient's tongue should be depressed with a tongue depressor and the tip moved gently from side to side in such a manner that the irrigating fluid will reach all parts of the pharynx. Should it be inadvisable to have the patient in a sitting posture, the

irrigation may be performed with the patient lying in bed with his head turned to one side.

Aural or ear douche.—The following appliances are required in this treatment: (1) An irrigator; (2) rubber tubing 12 inches long; (3) pus basin; (4) a small rubber dressing sheet; (5) a dressing towel; (6) sterile absorbent cotton; and (7) solution of boric acid, 2 per cent or a specially ordered solution, at a temperature of 100° to 105° F. The patient should sit with his head inclined to the side or lie in such a position that the affected ear is uppermost. The rubber sheet, covered with a dressing towel, should be applied to protect the clothing; the irrigator filled with the desired solution and placed about 12 inches above the ear. Any discharge about the outer ear should be removed by gently wiping with cotton. Gentle but firm tension in a backward and upward direction should be applied to the upper part of the ear, and the nozzle should not be placed beyond the opening of the auditory canal. The solution should be permitted to flow gently into the ear and out into the basin. If pain or dizziness is caused, the irrigation should be discontinued and the medical officer notified. When irrigation is completed the ear should be dried with small pledgets of absorbent cotton. This is done by holding the auricle in proper position, inserting a pledget of cotton and leaving it for a few seconds to absorb the moisture, and then removing it. This procedure is repeated with a dry pledget each time until the cotton, when removed, is perfectly dry. A pointed instrument should not be inserted into the ear in this procedure.

Eye douche.—The following appliances are necessary: (1) A basin containing about one pint of solution (boric acid 2 per cent, temperature 100° F., or specially ordered solution); (2) some sterile absorbent cotton sponges; (3) a basin to collect the solution as it flows from the eyes (pus basin preferred); (4) a small rubber dressing sheet; (5) a sterile dressing towel; (6) a basin for used pledgets; and (7) a probe or applicator. When cleansing the eye after operation, everything except the basin last named and the rubber sheet should be sterile. The operators' hands, and, at all times, everything used, must be scrupulously clean.

The patient sits or lies, as circumstances require, in such a manner that the head is tilted and the eye to be treated is lower than the other one. The rubber sheet, covered with the towel, should be adjusted and a basin placed in position to catch the solution as it runs from the eye. Any free discharge on the eyelids should be wiped away very gently with a cotton sponge wet in the solution (wipe from the inner toward, but not to, the outer angle, downward and outward from the outer angle). The same sponge should not be used more than once. One lid should be everted and a current of solution is then squeezed from a sponge over the eye, directing the current from the inner to the outer angle of the eye, otherwise the discharge may be washed into the lachrymal sac and a serious inflammation may result. The douche of the eye should continue in this manner until all of the discharge has been washed away. The other lid then should be everted and the process repeated. If both eyes are douched, separate utensils must be used; and the operator's hands thoroughly disinfected before douching the other eye. The uninfected eye should be shielded carefully. When the eye is not inflamed, it is not always necessary to evert the lids, they may be drawn apart with the thumb and forefinger, and the patient directed to look up. Drops not intended for cleansing purposes should be put into the outer angle of the eye.

An *eye cup* is a glass container small and oval in shape and should be filled two-thirds full of solution (boric acid, 2 per cent, at a temperature of 100°

F.). The patient's head should be bent forward and the cup pressed firmly over the closed eye; then holding the cup in position, the patient should throw his head backward and open and close the eye alternately for two, three, or five minutes. The head then should be bent forward and the cup removed.

REFERENCES.

Practical nursing.—Maxwell and Pope.
Modern methods in nursing.—Sanders.

Operating Room and Surgical Technique.¹

When we speak of an operating room we speak broadly, meaning not only the room where we actually operate but all the other rooms directly associated. This section of a hospital or of the sick bay aboard ship is a most important place, and upon its equipment and care depend to a considerable extent the success or failure of an operation. Of course surgeons often are required by necessity to perform operations under conditions far from satisfactory; for instance, under war conditions or in isolated farmhouses. However, whenever possible, operations of a major character should be performed in hospitals where the patient can be safeguarded by all possible aseptic conditions.

The operating room.

The actual size of the operating room should be determined by the number and character of the operations to be performed and the space available. However, it should be sufficiently large to preclude the necessity of crowding, yet not so spacious that it is difficult either to clean, ventilate, or heat.

Lighting.—Good lighting is of paramount importance by day and night. Da Costa writes, "In northern latitudes northern light is the best," because with this exposure the trying glare of the sun is avoided. Large windows are desirable, preferably of plate glass, and with as few sashes as possible. Storm windows should be installed, either of the temporary or permanent variety, for during the cold months the heat loss through a single layer of glass, without an insulating air space, is great. A skylight, likewise of the storm-window type, is much to be desired. Adjustable curtains for the skylight and windows are necessary in order that there may be appropriate gradation of light, taking it for granted that the operating room is inaccessible to the gaze of unauthorized individuals.

As a general rule, routine operations are performed during the hours of daylight, preferably in the morning, because by so doing the patient is saved much anxiety and the surgeon is at his best mentally and physically. Emergencies arise when it is necessary to operate by artificial light. The direct system of lighting in which electric lights with parabolic reflectors are suspended at the proper focal distance from the operating table is almost universal and quite satisfactory. The indirect system of reflected light is expensive, complicated, and as a rule unsatisfactory, unless a very complex system of accurately angulated mirrors has been installed so that no shadows are thrown on the operative field.

In addition to the lights over the operating table, there must be provided several appropriately located side lights and wall sockets for the convenient attachment of electrical instruments.

The electric current for some reason may fail, and to provide for this contingency several flashlights should be kept ready for immediate use and storage batteries installed capable of supplying current to two 25-watt portable lights for two hours.

¹ Prepared by Commander C. M. Oman, Medical Corps, United States Navy.

Gas as a substitute for electricity is undesirable, because ether in the presence of a flame is a menace and so much heat may be generated by the burning gas that the operating room becomes insufferable.

Ventilation.—The ventilation of an operating room must be as nearly perfect as possible. However, the structural details of this problem essentially concern the engineer and architect. Suffice it to say that fresh, clean, warm, moist air should be constantly provided and drafts avoided. It is well also to emphasize the importance of having a vestibule entrance to the operating room, for frequently an operation otherwise successful has ended disastrously because the patient was chilled by a draft from a cold corridor into which the door directly opened.

Heating.—The heating equipment should be either steam or hot water, designed to maintain a temperature of 80° F. under all weather conditions. A hot-air system should not be used because of the dust and dirt which it stirs and scatters broadcast. The ideal temperature for operating is 78° F., but a variation of 1 or 2 degrees is difficult to prevent, and of no practical importance. An overheated operating room saps the vitality of the surgeon and his assistants.

The patient's body must be kept warm, and to accomplish this purpose, yet avoid excessive heat in the operating room, there are manufactured operating tables, warmed by electricity or by hot-water coils, but, as a matter of fact, such a table is not necessary provided hot-water bottles are placed judiciously and the patient covered with warm blankets before and during the operation. On the other hand, an underheated, chilly operating room is dangerous to the patient as a predisposing cause of surgical shock and pneumonia.

Equipment.—It might well be noted that the history of medicine is replete with accounts of the most excellent work done without instruments and equipment now usually considered indispensable, and the man capable of adapting himself to circumstances, accomplishing his purpose despite incomplete equipment, is sought for and singled out among many. Originality and initiative are essential qualities of the surgeon or surgical assistant.

An operating table with all accessories, adjustable as to height and the various standard positions, is desirable, but this type of table is expensive, and quite as good work may be performed on one of a simple design, provided proper forethought is given the type of operation and the required position of the patient. On the table there should be a soft pad about 1½ inches thick covered with rubber sheeting and over all a linen sheet. In addition to the operating table but few pieces of apparatus are necessary. There should be two or three tables with glass or polished metal tops—preferably metal—for surgical dressings and instruments to be used during the operation, one single and one double hand basin stand, an irrigating stand, two enamel buckets with covers, and a set of glass shelves for solutions, ligatures, drains, pins, etc. All the operating-room accessories should be of simple, sturdy, easily cleaned design, and should be painted with a durable white enamel.

Cleanliness.—The walls and floor of the operating room should be built of waterproof material with a smooth surface and so constructed that sharp, dirt-collecting angles are avoided. Glazed porcelain tile for the walls and unglazed porcelain tile for the floor are admirably suited for the purpose in hospitals on shore, but on battleships, while it may be possible to have a tiled floor, the walls are usually steel, painted white, because the great vibration caused by gunfire might loosen or crack a tile wall. The floor should be washed daily with soap and warm water and the standing equipment wiped with a moist cloth. Once a week a hose should be played over the walls and the floor washed with any of the standard soap powders. During an operation

the blood and other stains on the floor should be removed as quickly as possible, and, if a second operation is to be performed immediately, the floor, if necessary, should be cleaned by hand and not with a mop.

Adjoining rooms.

Adjoining an operating room in hospitals on shore and on hospital ships certain additional rooms, as noted below, are desirable:

1. Anæsthetizing room.
2. Wash room.
3. Cleaning-gear room.
4. Sterilizing room.
5. Surgical-dressings room.
6. Storeroom.
7. Instrument room.

Anæsthetizing room.—The anæsthetizing room should be equipped with a revolving stool and a stand on which should be—

1. Etherizing mask.
2. Gauze strips.
3. Ether (in original cans).
4. Hypodermic outfit (complete).
5. Adrenalin hydrochloride.
6. Mouth gag.
7. Tongue forceps.
8. Boric acid solution, with eye dropper.
9. Boric acid ointment.
10. Sphygmomanometer.
11. Anæsthetist's chart.
12. Clock, with second hand.
13. Pus basin.
14. Pharyngeal tubes.

In addition to the equipment as described above there should be an up-to-date machine for using nitrous oxide and oxygen in conjunction with ether.

Wash room.—In the wash room there should be at least two lavatories, with foot or knee control for the hot and cold water, a shower bath and toilet, and clothes lockers for the use of the surgeon and his assistants when they change into the operating suits. It is well also to have in this room a basin stand for the solutions used to disinfect the hands after the preliminary scrubbing, in order that when the surgeon enters the operating room he is ready to receive his operating gown and proceed without delay.

Cleaning-gear room.—Leading into the wash room should be a room for the cleaning gear used in the operating room. In this room should be a large deep sink with running hot and cold water, in which the linen used during operations may be soaked and the greater part of blood stains removed before sending to the laundry. The cleaning-gear room, it should be remembered, is an integral part of the operating-room equipment, and as such must be scrupulously cared for.

Sterilizing room.—The standard Navy sterilizing equipment consists of—

1. Utensil sterilizer.
2. Instrument sterilizer.
3. Hot sterile water tank.
4. Cold sterile water tank.
5. Autoclave.
6. Glass-lined tank for sterile normal salt solution.

This is complete in itself and should be in the sterilizing room. Despite the fact that this equipment is sturdily constructed, constant care must be taken that it is always in working condition and the printed directions furnished by the manufacturers exactly observed.

The autoclave is the machine used to sterilize or make safe for surgical use, by steam under pressure, the various dressings and solutions used in the operating room. It should never be entrusted to an inexperienced or careless person, for in inexperienced or careless hands it is dangerous, as it may fail to kill infectious organisms, thereby endangering the lives of patients.

Surgical-dressings room.—The surgical-dressings room should be constructed similarly to the operating room, with tiled walls and floor. In this room are made, prepared, and stored, after sterilization, the various surgical dressings and packages of linen, such as gowns, sheets, towels, etc., used in operations. Here cleanliness is of paramount importance. Ample locker and shelf space should be provided, and also a large smooth-top worktable.

Storeroom.—There should be a storeroom solely for the storage of operating-room supplies. Much valuable time may be lost unless such a room is provided and kept fully stocked in anticipation of emergencies.

Instrument room.—An instrument room, while not a necessity, is advantageous. However, as a rule, unless the clinic is unusually large and of great variety, suitably designed glass cabinets placed in the surgical-dressings room will suffice.

SURGICAL TECHNIQUE.

Years ago patients and surgeons dreaded operations because of the great number of deaths resulting from infection through the operative wound. It was believed that wounds were infected by bacteria in the air, and during an operation the operating room was sprayed with an antiseptic solution, but now we know that infection is due to bacteria introduced directly into the wound from the skin of the patient or by the hands, unclean instruments, or other equipment used during an operation, and that the bacteria in the air play a very minor part in the infection of wounds—in fact, so small a part that this mode of infection may be disregarded.

Asepsis.—The ideal of modern surgery is to prevent infection by having everything which comes in contact with the patient at the time of operation, and at subsequent dressings, *surgically clean*—free from bacteria—**ASEPTIC**. Asepsis is difficult to maintain and constant vigilance must be exercised before, during, and after an operation to attain this end, and no failure of technique, however trivial, should pass uncorrected.

Infection.—Infection is said to exist when pathogenic bacteria (or germs capable of causing disease) gain access to the tissues of the body in such numbers that their presence is made manifest by characteristic symptoms.

Inflammation.—Inflammation well may be described as the first objective (outward) symptom of infection and is characterized by local pain, heat, redness, swelling and disordered function. The general or subjective symptoms of inflammation vary greatly, depending upon the amount and anatomical location of tissue involved, the physical condition of the patient, and the virulence (poison production strength) of the infecting organism. Fever is the most constant subjective symptom of inflammation, but it may be so slight that it escapes notice and on the other hand it may be so severe that recovery of the patient seems doubtful. Aseptic treatment and careful observation of wounds, traumatic or operative, is imperative, in order that in the first place infection with its subsequent possibilities may be prevented and, secondly, if infection does occur it may be recognized promptly and appropriately treated.

Suppuration.—Suppuration is the result of inflammation and is due to the liquefying action of pyogenic (pus producing) organisms on the exudates of tissues damaged by inflammation and also upon the tissues themselves, forming *pus*.

Sepsis.—When a wound has become so infected that the inflammation does not subside and pus forms, it is termed a "septic" wound. Frequently, as a result of the passage of bacteria from a septic wound into the blood stream or of the absorption of the toxins (poisons) elaborated by the bacteria, grave general symptoms are caused and sepsis (blood poisoning) is said to be present.

Putrefaction.—By putrefaction we mean that inflammation has so far progressed that the tissues have been devitalized and a foul or putrid odor arises from the wound. The putrid odor is due to the action of putrefactive bacteria—e. g., colon bacillus of malignant œdema, etc.

Pyogenic bacteria.—The various strains (varieties) of the staphylococcus and streptococcus are the causative agents in the majority of surgical infections. Other organisms such as the *Bacillus tuberculosis*, *Bacillus anthracis* (bacillus of anthrax), *Bacillus mallei* (bacillus of glanders), the *pneumococcus*, *Bacillus coli communis*, *Bacillus tetani* (bacillus of lockjaw), *Bacillus aerogenes capsulatus* (gas bacillus) are, however, frequently demonstrable. The *staphylococcus* is the most common cause of infection. It rarely causes alarming constitutional symptoms, and as a rule such an infectious process remains quite localized. The *streptococcus* is more virulent and tends to invade the whole system. Infection of wounds by one type of organism is quite rare; two or more varieties usually are present and the coincident symptoms are dependent upon the predominating bacterium, either because of its virulence or numbers. It is well to note that the encapsulated spores or buds of the bacillus anthracis are the most difficult of all germs to kill, and any process which will render them harmless (and they must be dead to be harmless) may be relied upon to accomplish the same result as regards the other bacteria.

Antiseptic, disinfectant, and deodorizer.—An antiseptic agent is one which inhibits (stops) the growth of or kills the bacteria but not the spores, and a disinfectant or germicide is an agent which will kill not only bacteria but also spores. The terms antiseptic and disinfectant, while literally they may be differentiated, are now, from a practical standpoint, considered synonymous and may be correctly used interchangeably.

A deodorizer is neither a germicide nor an antiseptic, but merely an agent which destroys or renders less offensive disagreeable odors. Charcoal is perhaps the best example of a deodorizer. Antisepsis and sterilization are general terms indicative of measures taken to prevent or inhibit infection.

The disinfectants in common surgical use are:

1. Alcohol 70–95 per cent.
2. Phenol (carbolic acid) 95 per cent.
3. Corrosive sublimate (bichloride of mercury) 1–200, 1–100

The antiseptics customarily used for surgical purposes are:

1. Alcohol 70 per cent.
2. Phenol $\frac{1}{2}$ to 5 per cent.
3. Corrosive sublimate solution 1 to 5,000, 1 to 10,000.
4. Boric acid, saturated solution.
5. Tincture of iodine 2 to 7 per cent.
6. Permanganate of potash solution 1 to 1,000, 1 to 5,000.
7. Harrington's solution.
8. Dakin's solution.

Normal salt solution is a 0.85 per cent solution of salt (sodium chloride) in water, which should be freshly distilled (8.5 grams of salt in 1,000 c. c. of water).

Sterilization.

Sterilization is a process by which infectious organisms and their spores are killed. There are three methods of sterilization: (1) Mechanical, (2) thermal, and (3) chemical.

Mechanical sterilization.—Mechanical methods of sterilization are undependable and are usually but preliminary steps to sterilization by heat or chemicals. There are two general methods now in use:

- (a) Scrubbing.
- (b) Irrigation.

(a) A thorough preliminary scrubbing, with soap and water, of a part of the body, or any article for surgical use, is frequently of great importance. The best example of the necessity of this procedure is the preparation of the hands of the surgeon and assistants for an operation. All instruments, enamel ware, and glassware should be thoroughly washed with soap and hot water immediately after use, as this process removes most of the germs and makes subsequent sterilizations more easily effective.

(b) The *irrigation* of wounds with sterile water or other aqueous solutions has a distinct place in modern surgery. Running water is a splendid mechanical cleanser, and, in many cases, will remove infectious organisms when other methods fail.

Thermal sterilization.—Heat is the most efficient agent of sterilization and, when properly used, is absolutely certain in its germicidal action.

The use of *moist heat* as a sterilizing agent is best discussed under two headings:

- (a) Boiling water.
- (b) Live steam (normal pressure or increased pressure).

(a) *Boiling water* is the simplest method of sterilization, killing anthrax spores in three minutes. This method is used chiefly for sterilizing instruments (except those with lenses), glass and metal ware. In emergencies surgical dressings may be boiled, but it is far more satisfactory to have them dry at the time of operation.

(b) *Live steam* is air-free steam and for sterilization purposes is used under normal or increased pressure. Steam under increased pressure is termed superheated steam and is the best method of sterilization. Steam at normal pressure is but little used at the present time.

An *autoclave* is a sterilizer in which steam under pressure (superheated steam) is used. A vacuum first is created to insure penetration of the steam, and when the proper reading of negative pressure (vacuum) is registered in the gauge superheated steam is admitted to the chamber and the articles therein subjected to a steam pressure of 15 pounds for one-half to three-quarters of an hour. At the end of this time all organisms will have been killed and the dressings or other articles rendered safe to use, but they are wet. A second vacuum then is induced and maintained until they are dry. One such sterilization ordinarily is sufficient to preclude the possibility of infection, but that there may not exist the slightest doubt as to the asepsis of the sterilized material the process is repeated two or three times, despite the fact that anthrax spores are killed by live steam in 12 minutes. This method of repeated sterilization, either by steam or boiling, is termed *fractional sterilization*.

The method of sterilization in which *dry heat* is used includes the use of the actual cautery, a flame, or hot air. Hot air is fairly satisfactory and it will kill anthrax spores in about three hours at 140° C. The cautery is a positive germicide, but causes extensive destruction of the tissues. Sterilization by a flame is rarely, if ever, used in surgery.

Chemical sterilization.—Many chemicals will kill bacteria and spores, but in order to do so promptly such a strong solution or concentration must be used that the tissues likewise are destroyed. This result is usually undesirable. Therefore the use of chemicals as sterilizing agents is confined chiefly to the sterilization of instruments which boiling or steam would ruin, or in weak solution as an adjunct to the mechanical method of sterilization. However, chemicals in solution of appropriate strength have a distinct field of usefulness in the treatment of infected wounds.

Below are briefly described some of the more common chemical disinfectants (germicides).

Alcohol in strength varying from 50 to 95 per cent is used for the disinfecting of cutting instruments, disinfection of hands of surgeons, and cleansing the skin of sebaceous material preparatory to the application of iodine.

Iodine (7 per cent tincture) is a reliable germicide, and its chief use is as a skin-disinfectant, but it is used also in the treatment of infected wounds. Its action, however, is much impaired by a wet or greasy surface.

Bichloride of mercury has very little power of penetration in strong solutions, but in weak solutions is a powerful germicide for superficial germs. Bichloride of mercury as a germicide in deep wounds is of comparatively little value, as contact with the tissues forms an albuminate of mercury and hinders the subsequent action of the drug. Instruments never should be sterilized in a solution of this drug because of its corrosive action.

Carbolic acid (phenol) is less powerful than bichloride of mercury and its chief use in surgery ($\frac{1}{2}$ to 5 per cent solution) is as a substitute for boiling or steam sterilization, and in 95 per cent solution as a local cauterizing agent. Carbolic-acid dressings should not be used because of the possibility of subsequent gangrene.

Potassium permanganate is an excellent deodorizer and, in addition, is a good disinfectant for the hands in saturated solution.

Boric acid is a very mild antiseptic and generally is used in saturated solution (4 per cent) for the irrigation of infected wounds or the sterilization of instruments which heat in any form would destroy.

The active principal of *Dakin's* solution is chlorine, and when properly used is a most valuable and efficient disinfectant.

Formaldehyde is an excellent germicide and is used either as a gas or in solution. It is very irritating to the tissues and seldom is applied in a dressing; in weak solutions (1 to 2 per cent) it will prove a satisfactory sterilizing solution for instruments. Formaldehyde gas is perhaps the most satisfactory method of sterilizing instruments which heat or moisture would injure, such as webbing catheters, cystoscopes, etc.

Iodoform in contact with moisture frees iodine and is a good antiseptic, but its odor is so pronounced and disagreeable that its use, to a great extent, has been curtailed.

Surgical dressings.

Surgical dressings commonly are made from gauze, cotton, flannel, rubber, linen, etc. The gauze and cotton should be of good quality and capable of rapidly absorbing fluids.

It sometimes happens that the gauze, as received from the manufacturers, is sized—that is, coated with a starch preparation which makes it unfit for surgical use—and such gauze must be boiled in a 1 per cent solution of sodium carbonate in order to remove this sizing.

Each hospital is more or less individual as regards the design of its surgical dressings. As a general rule, gauze is used in four forms: (a) Sponges, (b) packs, (c) strips, and (d) in covering cotton pads.

(a) *Sponges*.—Formerly natural or sea sponges were used during operations, but, on account of the fact that they are practically impossible to sterilize, their use has been discontinued, and small squares of folded gauze, four or five layers in thickness, have been substituted.

(b) *Packs*.—Gauze packs usually are made of folded gauze 8 or 10 inches square and of 7 or 8 thicknesses, the gauze stitched around the sides. Attached to one corner is a tape. These gauze packs are used commonly for the purpose of “walling off” an operative area, and as they enter the abdominal cavity it is important that they be not lost. An instrument or metal ring is, as a rule, secured to the end of the tape in order that such a mishap is rendered less likely, or, if such an accident does happen and the pad is sewn up in the wound, its presence may be determined easily by the X-ray, which will show the metal ring or instrument.

(c) *Strips*.—Gauze strips deservedly are becoming more and more popular inasmuch as they are less likely to be misplaced. They may be of any convenient length, width, or thickness.

(d) *Cotton pads*.—Cotton is a most valuable adjunct in surgical dressings, but should not be placed on or in a wound without a protective covering of gauze, because the cotton fibers may be left in the wound and, as foreign bodies, cause or prolong an inflammatory process.

Gauze dressings should be made neatly and carefully, with no frayed edges, and should be made up in small packages covered with unbleached muslin or some other appropriate wrapping material. Common pins may be used to secure these coverings, the points of which should not show when the package is completed, in order that no infection may be carried into the dressings, caps, masks, etc., by the withdrawal of the pin.

Sponge count.—The number of gauze sponges or packs, etc., in a package should be standardized and the used sponges or packs, etc., counted and checked against the number contained in the original packages, so that if any are missing the loss may be discovered and search instituted before the abdominal wound is closed.

Operating-room linen.—Under the heading of surgical dressings may well be mentioned the operating-room linen and rubber gloves.

Sheets.—All sheets should be neatly and appropriately folded and made up in packages containing two or four each. It is necessary also to have on hand a supply of towels in packages of four each. Special operating sheets, with an oval opening in the center about 8 inches by 2 inches, known as laparotomy sheets, are used now universally, and may be packed either separately or included in the package of plain sheets.

Caps and masks.—In order to prevent infection of the operative wound by dandruff and droplets from the nose and mouth, the surgeon and assistants should wear caps and masks, which are made of cotton cloth and gauze. Sometimes the mask and cap are made of one piece of cotton cloth, but as a rule they are separate articles, and are put on before scrubbing the hands. Sterilization of these articles is not absolutely necessary but desirable.

Operating gowns.—Operating gowns are large, loose-fitting cotton garments extending from neck to ankle, opened down the back, and usually have long sleeves. The surgeon and assistants put on these gowns over a clean white operating suit, which is worn in preference to ordinary clothes, immediately after the sterilization of their hands.

The proper sterilization of sheets, gowns, masks, etc., is of great importance. They should be sterilized in an autoclave, under 15 pounds pressure for at least 30 minutes, and this process should be repeated at least three times in order that even the most remote possibility of infection may be removed.

Rubber gloves.—It is practically impossible to perfectly sterilize the hands, and therefore rubber gloves, which can be made absolutely aseptic, should be used at all operations. They serve the double purpose of protecting the patient and surgeon from infection. Rubber gloves may be sterilized either in an autoclave (dry sterilized) or by boiling. If an autoclave is used, two sterilizations, at 12 to 15 pounds pressure for 15 minutes, are sufficient. Longer sterilization and greater pressure rapidly rot the rubber. If the gloves are boiled, plain water should be used and the gloves boiled for 20 minutes. It is, as a rule, more convenient to put on dry rubber gloves.

Bandages.—Bandages are made of unbleached muslin, gauze, mull, and crinoline, in appropriate widths and as a rule about 10 yards long. Gauze bandages are in almost universal use and require no special description. The same may be said of muslin bandages, except that they are less elastic than the gauze bandages and are usually used when partial or complete fixation is indicated. Mull is an expensive cloth, but makes a durable bandage. Crinoline is a cotton gauze heavily impregnated with starch. Crinoline bandages (so-called starch bandages) are valuable when a light, fixed (hard) dressing is necessary and they are applied wet. Plaster of Paris bandages are made of a strong, coarse cotton gauze, loosely wound, into which plaster of Paris has been thoroughly rubbed. A plaster of Paris bandage accomplishes the same purpose as the starch bandage, but is much heavier, stronger, and more durable. It should not be applied directly to the skin, but over some sort of protective dressing such as cotton wadding.

Adhesive plaster.—The adhesive plaster in satisfactory general use to-day is made of firm cloth with, on one side, a sticky, rubber preparation impregnated with zinc oxide. Its adaptability for surgical purposes is almost unlimited and no surgical dressing equipment is complete without it.

Surgical drainage material.

The drains continuously used for surgical purposes are:

1. Tubes—(a) rubber, (b) glass.
2. Gauze drains.
3. Rubber dam drains.
4. Cigarette drains.
5. Horsehair or silk drains. (Figs. 100, 101.)

Tube drains.—(a) Rubber tubing makes an excellent drain for ordinary purposes and may be purchased in sterile glass containers ready for use or may, at the time of operation, be sterilized by boiling for seven minutes in plain water. To prevent the disappearance of a rubber tube into a body cavity, it should be secured to the skin either by a nonabsorbable suture or transfixed with a safety pin. (b) Glass tubing may be used for drainage purposes but it is dangerous, because of fragility and difficulty in securing.

Gauze drains.—Gauze drains should be carefully prepared with no selvage edge and sterilized by either steam or boiling. Their use usually is limited to small superficial cavities such as result from the incision of a furuncle. They should be changed frequently, for they rapidly cease to function and mechanically plug the sinus, thereby defeating its purpose.

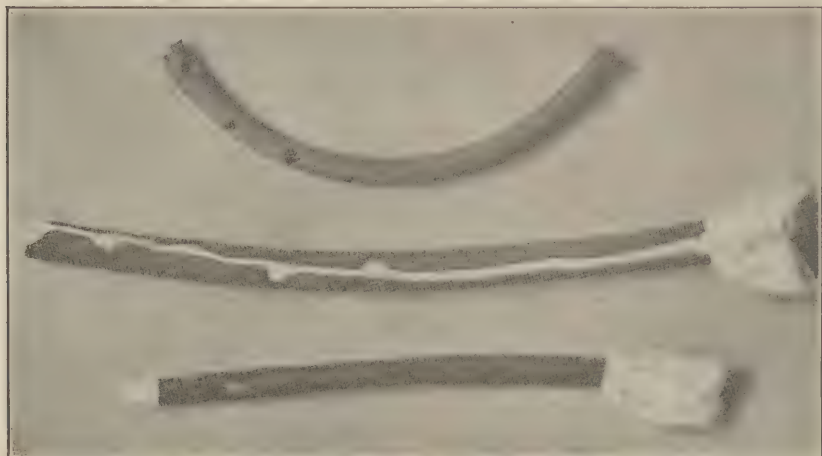


FIG. 100.—Rubber drains: Perforated rubber tube; split rubber tubing with several lengths of gauze; cigarette drain of rubber tissue with gauze inserted. (Warnshuis.)

Rubber dam drains.—Rubber dam is excellent drainage material and is sterilized by boiling in plain water for seven minutes. As a rule it is not irritating to the tissues and may be removed easily and painlessly.

Cigarette drains.—A cigarette drain is made by rolling a piece of sterile gauze in rubber dam so that the ends of the gauze project three-quarters of an

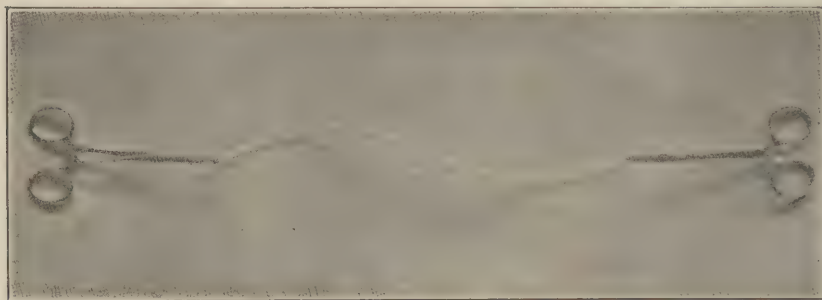


FIG. 101.—Silkworm-gut drain. (Warnshuis.)

inch beyond the rubber. This type of drain is used chiefly in abdominal surgery.

Horsehair or silk drains.—Horsehair or silk drains should be sterilized by boiling in plain water for 10 minutes. They make most excellent drains for small sinuses or cavities.

Sutures and ligatures.

Sutures and ligatures are made of absorbable and nonabsorbable material. Catgut is made from submucous coat of sheep intestines and usually is used sub-

cuticularly when an absorbable material is indicated, as for instance in tying a bleeding blood vessel or sewing a cut muscle. It now is prepared ready for use by various manufacturers put up in glass tubes which may be sterilized. Two kinds of catgut commonly are used—plain catgut in sizes 00, 0, 1, 2, 3, 4. (Plain catgut will last in the tissues about 8 or 10 days.) Chromicized catgut in the same sizes is prepared to last 10 to 20 days. Kangaroo tendon is made from the ligaments of the kangaroo's tail. It is very strong and is used particularly in the repair of hernia, lasting 20 to 30 days. Catgut and kangaroo tendon are the only dependable forms of absorbable suture or ligature material. Nonabsorbable sutures and ligatures are made from silk, horsehair, silkworm gut, and celluloid linen thread (Pagenstecher), silver wire and bronze wire. Such suture material is used chiefly for sewing skin wounds. However, celluloid linen thread is frequently used in intestinal surgery, but in many cases an absorbable suture material is used entirely.

Instruments.

It is of paramount importance that surgical instruments be kept in good condition. They should be washed thoroughly, preferably in cold water, immediately after an operation in order that the bloodstains, etc., may be removed more easily. After washing they should be dried thoroughly, particular attention being given the joints. Having been dried, they should be wiped with mineral oil or vaseline to prevent subsequent rusting. Surgical instruments, as a rule, are sterilized by boiling in a 1 per cent solution of sodium carbonate for at least 10 minutes. The sodium carbonate in the water prevents rusting. Cutting instruments, such as scalpels, scissors, chisels, etc., may be boiled, but it is better to immerse them in an antiseptic solution, such as a 70 per cent solution of alcohol or 5 per cent solution of phenol for 20 minutes. If they are boiled the cutting edge is dulled. Instruments should be kept in air-tight cabinets, but if such equipment is not available any clean locker may be used, provided, as suggested above, the instruments are kept thoroughly oiled.

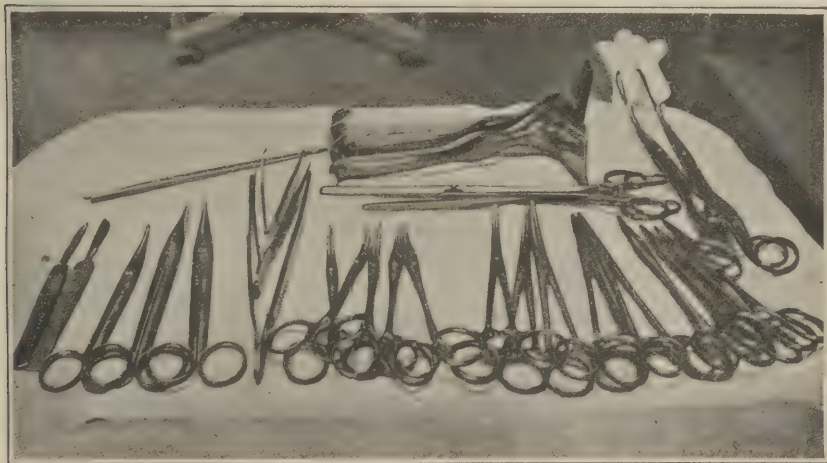


Fig. 102.—Instrument stand with instruments arranged. Note 2 scalpels, 3 Mayo scissors, 3 tissue forceps, 4 Kelly curved hemostats, 3 Mayo curved hemostats, 2 straight Mayo hemostats, 4 straight Kelly hemostats, 2 sponge sticks with sponges, 2 clamps, 2 pairs retractors, a blunt dissector, and an appendical tucker. (Warnshuis.)

It is impracticable to attempt a description of the instruments necessary for all operations. Certain ones always are used (listed below) and should be neatly arranged on an operating stand which extends over but does not touch the patient during an operation and is covered with a sterile cover. The others should be conveniently at hand on an instrument table. (Fig. 102.) If special instruments are necessary the surgeon or his assistant should select them prior to operating.

Instruments for use in all operations:

1. Scalpels (2).
2. Scissors (2), 1 straight, 1 curved.
3. Thumb forceps (2).
4. Kelly hæmostats (6).
5. Ochsner hæmostats (6), straight.
6. Ochsner hæmostats (6), curved.
7. Probe.
8. Retractors (2 pair, large and small).
9. Needle holder (2).
10. Sponge holder (2).
11. Towel clips (4).

Preparation of the hands.

There are many methods described for the preparation of the hands prior to operating. However, only one method, and, incidentally, the simplest and most satisfactory, used on the surgical service of the Naval Hospital, Washington, D. C., will be described:

"Scrub the hands and forearms to the elbow with a bristle brush and green soap in warm running water for 10 minutes. Wash the soapsuds off and immerse the arms to the elbow in a 70 per cent solution of alcohol for five minutes. Allow the alcohol to dry by evaporation."

Care of patient on operating table.

Before coming to the anæsthetizing room all foreign bodies in the mouth should have been removed, but it is well to inspect the patient's mouth as a matter of precaution.

Generally the patient is anæsthetized on the operating table, which is wheeled into the operating room. This feature of technique is quite desirable, because it obviates the necessity of lifting an unconscious, relaxed body, with the possibility of breaking bones, due to pendulant arms and legs. The operating table should be padded well so that the patient may rest comfortably. Prior to the administration of the anæsthetic the patient should be clothed in a cotton nightgown extending to the knees and open down the back so that at the time of operation there may be no difficulty in exposing the desired part. Loose, flannel, operating-room stockings coming well above the knee should be put on and the patient covered with a sheet and blanket. When anæsthesia is complete the sheet and blanket should be removed and the patient covered with two blankets, drawn lengthwise across the body, slightly overlapping at about the level of the umbilicus, so that the field of operation may be exposed without entirely uncovering the patient.

Preparation of patient for operation.

The desired part is exposed by folding back the blankets and wiped with gauze dampened with benzene. The purpose of the benzene is to remove the natural oils and greasy excretions of the skin, insuring prompt, efficient action of the tincture of iodine (U. S. P.), which then is applied liberally over a wide

surface. This method of skin preparation is well adapted for even emergency operations.

When the iodine has dried the patient is draped for operation with sheets and towels, so that only the surface immediately surrounding the incision is exposed. The more skin area uncovered the greater is the chance of infection, because it is practically impossible to render skin aseptic.

Operating room personnel.

The operating room personnel required and their duties are described immediately following (figs. 103, 104):

1. Surgeon.
2. First assistant surgeon.
3. Second assistant surgeon.
4. Operating-room nurse.
5. Surgical nurse.
6. Hospital corpsmen.
 - a. Hospital corpsman assistant.
 - b. Hospital corpsman, general detail.

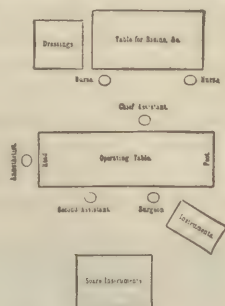


FIG. 103.—Diagram of arrangement of tables and assistants for abdominal operation. (Bryant.)

Surgeon.—The surgeon performs the operation and all others in the operating room are responsible to him. It should be remembered that often a patient's



FIG. 104.—The operative group. (Warnshuis.)

life is in his hands and that proper, willing, and intelligent assistance is of prime importance. (Fig. 105.)

First assistant surgeon.—The first assistant surgeon's duty is to immediately assist the operating surgeon, and as a rule stands opposite to him at the operating table.

Second assistant surgeon.—The second assistant surgeon also assists the operating surgeon, but stands beside him.

Operating-room nurse.—The duties of the operating-room nurse are mainly of a supervisory nature. It is taken for granted that her training is such that she is competent to and does instruct the others in the operating room technique. She assumes the responsibility for the efficiency of all routine measures and it is for her to see that all semblance of confusion is avoided. At the time of operation her main duty is to anticipate the needs of all the operating room personnel.

Surgical nurse.—The surgical nurse is first assistant to the operating room nurse and assumes her duties when necessary. During an operation she scrubs up and is responsible for the instrument and surgical dressings tables.

She should be the first to scrub and drape the tables with sterile sheets preparatory to assorting the dressings and instruments.

Hospital corpsmen.—There should be two hospital corpsmen detailed from the operating room force, and they should alternate in assisting the surgical nurse at operations. During an operation the hospital corpsman assistant should be in charge of the instrument stand which is extended over the patient and on which are the instruments constantly needed during the operation. He should keep these instruments clean and in place. In addition to caring for the instruments, he should see that sutures and ligatures are always ready and be prompt to hand either or both to the surgeon without delay.

The hospital corpsman on general detail is the general "handy man" in the operating room. He should be constantly on the alert to render service.

Preparation for an operation.—It is assumed that as described above the surgical dressings, i. e., sponges, strips, gowns, sheets, gloves, etc., have been sterilized and are on hand ready for use, and that ample warning has been given the operating room personnel to enable them to devote their whole time and attention to the coming operation.

(1) The operating-room nurse is informed that an operation for ——— will be performed at ——— a. m.

(2) The operating-room nurse directs the operating personnel to report at least 30 minutes before the time set for the operation.

(3) When the operation is such that special or unusual instruments are necessary, the hospital corpsman assistant selects the instruments to be used and puts them, wrapped in a cotton cloth, to boil in the sterilizer. With the instruments should be boiled three or four medicine glasses in which may be poured various disinfectants, such as iodine, carbolic acid, etc. In some hospitals the technique calls for the boiling of the glass tubes containing sutures and ligatures, but usually they are kept immersed in an antiseptic solution and are removed with sterile forceps when necessary.

(4) The hospital corpsman assistant and hospital corpsman on general detail place the hand basins, enamel pitchers, etc., in the utensil sterilizer.

(5) Fifteen minutes before the scheduled time of operation the cutting instruments are placed in the sterilizing solution.



FIG. 105.—Surgeon properly gloved and gowned. (Warnshuis.)

(6) All hands assist in placing the operating room equipment in convenient locations.

(7) The operating-room nurse and surgical nurse select the packages of sterile goods which they anticipate will be used and place them on the table in the surgical dressings room. (When a pack of sterile dressings is opened, care should be taken not to break asepsis.)

(8) The surgical nurse and hospital corpsman assistant put on caps and masks and "scrub up."

(9) The operating-room nurse hands the surgical nurse a sterile gown from a sterile package and assists her to put it on. The hospital corpsman on general detail does likewise for the hospital corpsman assistant.

(10) Both the surgical nurse and the hospital corpsman assistant put on sterile rubber gloves which are handed them from sterile packages.

(11) The surgical nurse drapes, with sterile sheets, the table for sterile gowns and gloves, the instrument table, the surgical dressings table, and basin stands.

(12) The hospital corpsman assistant drapes the instrument stand with a specially designed cover.

(13) The hospital corpsman on general detail carries the sterilized instruments and utensils in their trays to the hospital corpsman assistant, who places the instruments on the instrument table and the hand basins on the draped stands.

(14) The operating-room nurse opens the sterile packs and hands the surgical nurse the surgical dressings, sterile sheets, towels, etc., which she places on the surgical dressings table.

(15) The hospital corpsman assistant is handed the sterile gowns and gloves intended for the surgeon and his assistants, which he places on the table prepared for that purpose.

(16) The surgical nurse and hospital corpsman assistant sort and arrange the instruments on the instrument table and prepare the ligatures and sutures.

(17) The hospital corpsman assistant selects the instruments, sutures, and ligatures, as described in a previous paragraph, and places them on the instrument stand.

(18) Having accomplished the above, all instruments and supplies are covered with sterile sheets and the surgeon notified that the operating room is ready.

(19) The surgeon directs that the patient be taken to the anesthetizing room and the anæsthetic administered.

(20) The surgeon and the first and second assistants "scrub up" and put on sterile gowns and gloves.

(21) The patient, completely anesthetized, is brought into the operating room.

(22) The hospital corpsman on general detail wipes the skin of the patient at the site of operation with gauze moistened with benzine.

(23) The surgical nurse hands the first and second assistants sponges, held in hemostats, with 7 per cent tincture of iodine, with which they "paint" the area cleansed with benzine.

(24) The hospital corpsman assistant and the second assistant drape the patient with sterile sheets and towels so placed that only a small area of skin remains exposed for the incision.

(25) The surgeon comes to the operating table; all assume proper places.

(26) The hospital corpsman assistant hands the surgeon the scalpel and the incision is made.

It should be remembered that most patients are unfamiliar with hospital routine, and that they come to a hospital for the relief of pain, either mental or physical, and are naturally quite anxious. The most casual remark may be exaggerated, and all conversation within the hearing of the patient should be reassuring.

When a patient is going under an anæsthetic loud talking or rattling instruments is frequently terrifying and should not occur. Great care should be taken in this respect during an operation under local anæsthesia. Keen assistance and operating "teamwork" will obviate conversation to a great extent, and there is no excuse for dropping or rattling instruments.

During an operation all evidence of haste, hurry, or confusion should be avoided. Peace, quiet, and tranquillity should prevail. Emergencies should be met with confident anticipation and with no outward manifestation of the unusual. The patient's welfare is the ultimate aim of surgery, and to this end all effort must be conscientiously directed.

REFERENCES.

Principles of Surgical Nursing.—Warnshuis.
Modern Surgery.—Da Costa.

Anæsthesia.¹

INTRODUCTORY REMARKS.

Anæsthesia is the state in which total or partial loss or absence of feeling or sensation exists and may be the result of disease or injury or the application or inhalation of anæsthesia-producing drugs. It is known as "general" or "local" (regional) according to the extent of insensibility.

General anæsthesia produces a state of unconsciousness, associated with general loss of sensation, including, of course, the loss of sensibility to pain, and usually is induced by inhalation, but may be caused by the introduction of various agencies into the system by other channels than the respiratory tract.

Local anæsthesia (more properly called analgesia) produces loss of sensibility to pain without the loss of the other sensations, such as heat, touch, etc. The area involved depends upon the site of injection of the analgesic agent and may include extensive areas or regions of the body. When so employed it is also termed regional anæsthesia or analgesia. The administration of local analgesic agents is performed usually by the operating surgeon with or without the aid of an assistant.

The principles governing the administration of general anæsthetic agents have advanced remarkably during recent years. Formerly, and to a large extent at the present time, the various factors influencing the proper induction of an anæsthesia have been and are neglected. In large hospitals where a number of operations are performed daily the tendency is to hurry the patient for the waiting surgeon, thereby forcing the patient under the influence of the anæsthetic as rapidly as possible and employing excessive quantities of the agent in a short period of time. This practice very frequently produces a greater degree of narcosis than is either necessary or desirable, increases the danger to the patient unnecessarily and prolongs the stage of recovery from the anæsthetic, and by increasing the surgical shock frequently prolongs the convalescence of the patient.

¹ Prepared by Lieut. W. W. Behlow, Medical Corps, United States Navy.

The development of specialists in anæsthesia during recent years has increased the knowledge of this very important branch of surgical procedure. As a result of this specialization many important facts concerning anæsthesia have been learned. The trained anæsthetist is not satisfied with merely keeping his patient under the influence of the anæsthetic, as was formerly the practice, but endeavors to induce and maintain a light, even, surgical stage of anæsthesia during the entire operation. The various factors which influence the proper administration of the anæsthetic are discussed in detail in another section.

The successful administration of a general anæsthetic by inhalation depends upon the maintenance of efficient respiration, the regulation of the dosage of the chosen drug, and the preservation of adequate temperature, circulation, blood pressure, and vitality of the patient.

The anæsthetist is required in many instances to assume great responsibilities and should be thoroughly equipped mentally and physically for his duties. He should possess perfect senses of sight and hearing, keen scent, and gentleness of touch. He also should acquire a thorough knowledge of the methods of handling patients and dealing with them with tact and courtesy. In this connection it should be emphasized that patients awaiting operation frequently and needlessly are alarmed by the carelessly and thoughtlessly spoken word of the attending hospital corpsman. This is especially true in the operating room during the early stages of anæsthesia when the patient appears to be unconscious. At such times his hearing is often very acute and he is likely to hear conversation concerning his condition which might cause him needless anxiety and add to the risks of the operation. In hospitals patients are usually under the influence of the anæsthetic before they are transported to the operating room. On board ship and at smaller shore stations this is often not practicable and the administration of the anæsthetic is begun in the operating room. Under the latter conditions it is not very pleasant to the patient to hear needless discussion of either his own or other cases nor to listen to the noisy handling of instruments and other surgical equipment.

While a patient is under the influence of an anæsthetic, particularly during the period of recovery, he is frequently very talkative, even garrulous. During this period he is likely to make statements which during his conscious, saner moments he would hesitate to make. He may at times be very offensive in his speech. It is the bounden duty of attending hospital corpsmen to consider all such statements as strictly confidential and privileged communications. Information obtained from a patient under these circumstances never should be disseminated. After recovery from anæsthesia, a patient frequently is worried by the thought that he disclosed information that might prove very embarrassing, and he questions his attendants concerning his conduct during the period of anæsthesia. At such times a diplomatic and tactful reply always is indicated.

As patients frequently become violent during the early stages of anæsthesia there always should be at least one other person in addition to the anæsthetist present during this period in order that the patient may neither do injury to himself nor to the anæsthetist.

Female patients are frequently the victims of delusions while under the influence of a general anæsthetic. As a matter of precaution it is advisable under such circumstances to insist upon the presence of a third person.

The responsibility of the anæsthetist does not terminate with the completion of the operation. He is directly responsible for the patient during the transportation of the latter to the recovery room or to his bed and until properly relieved by a competent attendant.

GENERAL ANÆSTHESIA.

Preparation of patient for operation.—The success of anæsthesia in regard to the ultimate recovery of the patient depends largely upon the preliminary preparation, the treatment during the course of the anæsthesia, and the care of the patient after the anæsthetic has been discontinued.

The condition of the patient will, of course, be the deciding factor in whatever preparatory treatment is given. In hospital practice it is usually practicable in ordinary cases to devote sufficient time to the preparation of the patient. On board ship and at smaller stations, when operative procedure is considered necessary and a hospital is not available, such operations frequently assume an emergency status, and proper preparation is not always possible. In both groups of cases the hospital corpsman will be guided by the instructions of the medical officer.

The following suggestions concerning the management of surgical cases from the anæsthetist's viewpoint are considered to be of value in the ordinary surgical case. All are subject to modification by the operating surgeon and should not be carried into effect without his specific instructions.

A warm bath, if the condition of the patient permits, with thorough cleansing of skin, should be given the night before operation. At this time all hair over and adjoining the area of operation should be removed with scissors and razor.

In order to avoid all possible sources of infection of the respiratory tract and to decrease the incidence of inhalation pneumonia, the hygiene of the mouth and nasal passages should not be neglected. A suitable mouth wash and spray should be used frequently up to the time of operation. A careful notation of loose, pivot, or artificial teeth should be made, and any removable teeth, plate, or other object removed prior to the administration of the anæsthetic.

The bladder should be emptied either voluntarily or, if absolutely necessary, by catheterization before the operation. If practicable and time and the condition of the patient permit, the intestinal tract should be emptied, using for this purpose a purgative, 24 hours prior to operation, followed in 8 hours by an enema. Such a procedure is not applicable to abdominal cases, which always require special preparation.

The diet prior to operation is subject to so many changing factors that it is safe to withhold all food unless instructions to the contrary are received. The same rule applies to the giving of water and other liquids.

During this course of preparation the hospital corpsman always should remember that the mental or psychic state of the patient must be carefully considered in order to insure a smooth, safe, and satisfactory anæsthesia. Therefore anything that will cause or increase fear or anxiety will militate against what otherwise might be a successful anæsthesia. As far as the patient is concerned, he is, in his own opinion, the only individual of consequence under medical care at that particular time and he expects the utmost consideration. Every effort should be made to make the patient's thoughts run in pleasant channels.

Medical treatment prior to operation includes measures to insure rest and quietude and proper functioning of the essential organs, such as the heart and circulatory system, and to counteract the effects of disordered function brought about by disease. It is the practice of many surgeons to administer an opiate hypodermically shortly before the operation. This opiate usually is morphine and frequently is combined with atropine, which drug counteracts the depressing effect of the morphine on the respiratory center and also inhibits the secre-

tory activities of the respiratory tract. *The hospital corpsman never should administer any drug without specific instructions from the medical officer.*

The preliminary preparation of the patient in the more difficult cases and in emergencies depends entirely upon the patient's condition, the amount of time available, and the surrounding conditions. In such cases it is essential that the hospital corpsman await instructions from the medical officer. As it is believed that sterilization with iodine preparations is less effective in the presence of moisture, preparation of the field of operation, including shaving of the hair within 12 hours of operation, should be performed without the use of water or other liquid preparations. In such cases the maintenance of absolute rest and abstinence from food and liquids is of the utmost importance. It is frequently advisable and necessary to wash out the stomach prior to operation in order to prevent vomiting during anæsthesia, with its attendant danger of inhalation of foreign substances and of obstruction to proper respiration. As will be noted in another section, a similar procedure often is followed upon completion of the operation.

In all cases the care of the patient on the operating table is extremely important. As the body temperature usually falls during anæsthesia, it is essential that the patient be covered with at least two blankets during the operation. The patient's arms must not be allowed to hang down over the side of the operating table, nor should they be allowed to assume unnatural positions, causing unusual pressure which may result in paralysis of nerves, especially the musculospiral (radial) nerve.

The general type of operation usually is known to the anæsthetist, and he therefore should provide the necessary attachments for the table to maintain the patient in any of the positions required by the surgeon.

The maintenance of respiration is all important, and it is essential that unnecessary pressure upon the thorax, such as may be caused by the surgeon's arms or by instruments, be eliminated. The patient's clothing should be quite loose, though warm. In the case of nitrous oxide, frequently administered in day clothing, especial care must be taken to loosen all clothing about the neck, chest, and upper abdomen, thus eliminating the possibility of pressure, which may cause cessation of respiration.

Anæsthetist's table.

The average anæsthesia in the ordinary surgical case is completed without incident or difficulty. Although most of the difficulties encountered are respiratory and easily can be overcome without the aid of instruments, it is occasionally necessary to adopt unusual measures to maintain a clear air passage.

The anæsthetist always should have the following equipment at hand and immediately available for use in an emergency (fig. 106):

- (a) Wooden mouth gag.
- (b) Tongue forceps.
- (c) A curved needle threaded with silk, sterilized, and in a sterile package.
- (d) Sterile hypodermic syringe with the following drugs in sterile solution in appropriate containers:
 - Caffeine sodium-benzoate.
 - Atropine sulphate.
 - Alcohol (or brandy).
- (e) Tracheotomy set.
- (f) Gauze strips.

- (g) Forceps (to hold gauze sponge).
- (h) Watch or small clock.
- (i) Pus basin.

This equipment is placed on a small table near the anæsthetist and within easy reach. It never should be necessary to ask for any of these important articles during anæsthesia, as delay in meeting an emergency may result in disaster.

In addition to the above list it is desirable to have an anæsthetist's chart for the recording of data, an extra supply of the anæsthetic agent, and, when necessary, a blood-pressure apparatus, should the surgeon request data on blood pressure during the operation.

Some cases require gastric lavage (washing out of stomach) during or upon completion of operation. It is essential, therefore, that a stomach tube be available in the operating room.

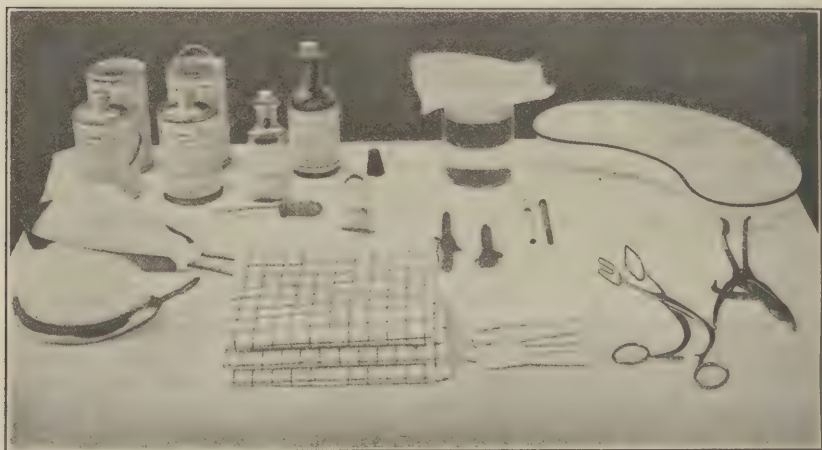


FIG. 106.—Anæsthetist's table of supplies. Cans of ether, chloroform, vaseline, castor oil, medicine dropper, hypodermic syringes, hypodermic tablets, glass of sterile water, vomitus basin, anæsthetic masks, towels, gauze, mouth gag, tongue forceps. (Warnshuis.)

Anæsthetic agents.

The agents or combinations of agents which fulfill the requirements of a general anæsthetic are nitrous oxide, ether, chloroform, ethyl chloride, and combinations and sequences of these with each other and with oxygen.

The choice of the anæsthetic to be used is left entirely to the medical officer in charge of the case, and is governed by the condition of the patient, the type of operation, the climatic conditions, and the type of agent available.

The hospital corpsman is particularly interested in the last two conditions. In very hot climates, as in the Tropics, it is frequently next to impossible to induct general anesthesia with ether, as it is so volatile that evaporation occurs almost immediately upon release from its container. Under such conditions it may be necessary to use chloroform. As nitrous oxide and ethyl chloride usually are not available in sufficient quantities outside of the hospitals, dependence must be placed upon ether and chloroform. It is therefore essential that the hospital corpsman become thoroughly familiar with the administration of these two anæsthetic agents, especially the former.

Administration of the anæsthetic in general anæsthesia.

Cardinal principles.—Insufficient oxygenation of the blood is the cause of most of the difficulties in securing a quiet, peaceful, satisfactory anæsthesia, and of a large percentage of fatalities in connection with the use of anæsthetics.

The first important object, therefore, is to maintain a clear air passage in the patient. The anæsthetist should familiarize himself with the signs of obstructed breathing and should be able to recognize and overcome these obstructions as they occur. The most common causes of obstruction of the air passages are partial obstruction of the nasal passages, frequently found in otherwise normal individuals; the presence of mucus in the mouth, pharynx, and naso-pharynx; firm closure of the jaws in the early stage of anæsthesia (patients with no teeth are prone to press their upper and lower gums together so firmly that very little or no air can enter); dropping of the lower jaw and "swallowing" of the tongue; position of patient with reference to mechanical pressure; spasm of the laryngeal muscles.

The only sure practice to follow in observing the patient's breathing is to hear or feel every respiration. As the patient's respiratory efforts continue, even after obstruction of the air passages, it is not enough that the anæsthetist should only see the chest and abdominal movements.

Mucus should be removed with a gauze sponge held in forceps. Dropping of the jaw and "swallowing" of the tongue should be overcome by light, even pressure under the jaw. In this connection it may be stated that long continued pressure over a small area of the jawbone may cause considerable soreness and tenderness for several days. It is occasionally necessary to hold the tongue forward by means of tongue forceps, although this procedure should be avoided if possible. Turning the patient's head to one side allows the drainage of mucus and other secretions and frequently prevents the backward drop of the tongue and jaw.

Laryngeal spasm usually is due to reflex action; a most frequent cause is too strong anæsthetic vapor. Withholding of the anæsthetic frequently will overcome the spasm. Impending vomiting with its resulting laryngeal spasm may be prevented by deepening the anæsthesia.

The question which naturally arises in each and every case is "How far is the patient under the influence of the anæsthetic?" It is essential that the anæsthetist know the exact degree of narcosis present at any and every given moment of anæsthesia. The requirements of the operation decide the depth of anæsthesia desired in each case. Constant practice in administering anæsthetics is necessary to obtain a knowledge of the finer details concerning general anæsthesia. The more important details will be discussed in that section devoted to the administration of ether.

Ether.

Properties.—A light, volatile, colorless, highly inflammable liquid with a peculiar penetrating odor and burning taste. Its vapors are heavier than air.

Caution.—Explosions and burning with fatal results have resulted from carelessness in the use of ether. Great care should be taken to avoid using this agent near an open flame, such as is found in a lighted gas jet, lamp, burning candle or stove, or in the vicinity of a hot cautery or electric spark.

Ether is administered by (1) the open or drop method, (2) the semiclosed (cone) method, or (3) the closed inhaler method.

In cold climates when the temperature does not cause too rapid volatilization of the ether, the open or drop method is the best, as the amount of mucus

secreted is generally much less, the tendency to coughing and labored breathing is decreased, the patient's color is better, and the pulse rate and blood pressure are well maintained. Most of the effects of deficient oxygenation of the blood do not occur, as this method permits the admixture of an adequate supply of oxygen from the air.

Patients addicted to the use of alcoholic liquors usually will prove unsuitable for this method, as they frequently require a rather forced administration during the second or excitable stage. For such individuals and in hot climates either the cone method or chloroform, preferably the former if possible, should be used. As the closed inhaler rarely is used outside of hospitals, no further mention will be made of its use. With the cone method, there is a tendency to administer the anæsthetic unevenly, with the result that the concentration of the ether vapor varies considerably, particularly during the first and second stages of the anæsthesia. This variation in concentration leads to reflex reactions such as spasms of the larynx, coughing, retching, etc. There is also a tendency with this method to force the patient under the influence of the anæsthetic.

Anæsthesia.—When ether is administered slowly by inhalation its action on the patient may be divided into four stages as follows: (1) *The stage of light anæsthesia*, in which occurs the primary decrease of consciousness accompanied by a feeling of asphyxia and ringing in the ears. Respiration is accelerated; the blood pressure is increased slightly; the pulse becomes full and bounding; and the color of the skin becomes heightened. Concentrated vapor in this stage will cause coughing, holding of the breath, swallowing, spasm of the glottis, muscular rigidity, turning of head from side to side and slight dilatation of the pupils. (2) *The stage of excitement*. In this stage the controlling centers in the cerebrum are depressed and there is incoordination of movements and speech, which may amount to violent struggling and shouting. Memory, volition, and intelligence are interfered with; consciousness is partially or wholly lost; marked rigidity of muscles supervenes: the pupils are dilated and mobile; secretions of the respiratory tract are increased markedly; the face is very flushed; perspiration is evident and the breathing may be irregular. As the patient passes from this stage to the third stage, vomiting is not infrequent. (3) *The stage of surgical anæsthesia*, when the cerebrum and spinal cord are paralyzed, sensation to pain is lost, and there is complete unconsciousness and relaxation. The respirations are deep, regular, and generally audible. A soft stertor may be considered normal. A strong stertor indicates obstruction of the air passage which requires immediate attention. The color of the face, ears, and lips is normal; the pupil is usually normal or contracted, but reacts to light; and the eyeball is eccentric or oscillatory. If the eyeball is stationary on center with pupil dilated, the patient is receiving too much ether, the administration of which should be discontinued at once. The lid reflex is weakly active; coughing and phonation are absent; and the heart action is accelerated. As anæsthesia progresses the face may become more flushed than normal. From the third stage the patient may change in the direction of consciousness or deepening narcosis, the fourth stage. Returning consciousness is indicated by the following signs: Respiration regular, not full, but quiet; pallor of face; moderate dilatation of the pupils with light reflex; increased activity of lid reflex; swallowing movements; return of phonation. (4) *The fourth or dangerous stage* is the stage of overdose of the anæsthetic. The medulla oblongata becomes paralyzed and asphyxia and weakened circulation follow. Death occurs in this stage from paralysis of the respiratory center in the medulla. The signs of the fourth stage are weak, shallow respiration,

cyanosis, soft feeble irregular pulse, dilatation of pupils with no reaction to light, absence of lid reflex, central fixation of eyeballs, separation of eyelids, and fall of blood pressure.

Method of eliciting the corneal lid reflex.—The reflex closure of the upper eyelid gradually diminishes in activity as anæsthesia becomes more profound. This reflex activity of the upper eyelid in response to stimulation of the cornea is considered one of the most important signs in determining the degree of narcosis. This sign may be elicited in the following way, according to Gardner: "Standing above or behind the patient, the pulp or palmar surface of the middle finger only of one hand should be gently inserted between the closed eyelids and made to draw the upper lid open as far as to disclose two-thirds of the cornea. Whilst doing this that finger pulp very gently but definitely brushes against the surface of the cornea, passing first over its exact center and then against the palpebral edge of the upper eyelid in one movement, which ends with the sudden letting go of the lid from the finger. The degree of activity with which the upper eyelid then closes constitutes the most invariable evidence of the extent to which the muscular and nervous systems are at the moment paralyzed by the anæsthesia."

Induction of ether anæsthesia.

Open or drop method.—When the patient is in as comfortable a position as possible the face should be anointed with a bland ointment and the eyes covered with a layer of gauze. The mouth and nose then are covered either with one of several types of gauze mask or with three or four strips of gauze. It is best to allow the patient to breathe several times with the gauze in position in order that the patient may become accustomed to its presence and also to determine whether or not the thickness of the gauze is too great to permit free and easy respiration.

Before beginning the administration of the anæsthetic, which to some patients may be very disagreeable, it is frequently desirable to drop a few drops of oil of bitter orange peel on the gauze. This is then followed by the ether, which should be administered drop by drop, very slowly at first, then gradually increasing the amount until the patient can take the strongest vapor. The ether should be dropped over an area involving the mouth and nares. The patient should never be hurried and should never be advised to breathe deeply, as a feeling of suffocation will ensue and the patient is also likely to struggle. During the administration of the anæsthetic the anæsthetist should talk constantly to his patient in order to maintain the latter's confidence. In other words, the anæsthetist should talk his patient to sleep. By this method under ordinary conditions the patient can be brought under the influence of ether in from four to six minutes.

Cone method.—This method differs little from that just described. It permits, however, rebreathing of the anæsthetic and in very hot climates is preferable to the open method, as there is less evaporation of the agent. In order to prevent too great a loss through evaporation, the cone may be surrounded with wet cold towels. In using the cone method it is always best to begin with the drop method, changing to the cone as the patient reaches the stage of surgical anæsthesia. With either method less ether is required to maintain the surgical stage of anæsthesia than is needed in either the first or second stage.

Chloroform.

Chloroform is a heavy, colorless, transparent, noninflammable liquid with a pleasant odor and burning, sweet taste. In general, it resembles ether in its

action, but is about three or four times more powerful and produces general anæsthesia much more rapidly. Its great danger is the marked depressant effect it exerts on the heart and circulation. Prolonged anæsthesia with chloroform may cause degeneration (alteration of the tissues) of the kidney and liver. As it has a marked local irritant action, great care must be used in the proper protection of the skin and eyes. It is less volatile than ether and therefore frequently is used in hot climates. It will not burn and therefore may be used in the presence of a naked flame or cautery. It causes much less activity of the secretory organs of the respiratory tract and rarely produces postnarcotic vomiting. It decomposes fairly readily with the formation of toxic substances; therefore only absolutely fresh chloroform from a sealed container should be employed.

The physiological action of chloroform causes a primary rise in blood pressure, followed by a fall considerably below normal; the pulse rate usually falls; and the color of the skin is heightened at first, but with the fall of the blood pressure the color becomes paler. The various changes in the pupils and the activity of the corneal lid reflexes are the same with chloroform as with ether anæsthesia. A more careful observance of the pupillary and lid reflexes is essential in chloroform anæsthesia. The effects of an overdose with chloroform appear with alarming suddenness, and for this reason it is necessary that every effort be made to administer the drug evenly, smoothly, and as lightly as possible. The best method to obtain these desirable results is the open or drop method.

Open or drop method.—Owing to the local irritant action of the drug it is essential that a mask be employed for the administration of chloroform. It is also desirable to anoint the face and necessary to cover the eyes as in ether anæsthesia. The administration of the anæsthetic is the same as in the case of ether, but even greater care is required in order that an overdose may be prevented. If the patient struggles with resulting sudden increase of respiratory efforts, or if the adult patient holds his breath, or if a child cries during the administration of the drug, remove the mask in order that the deep inspiration which follows these respiratory efforts will not cause inhalation of an excessive amount of the anæsthetic. During the second stage of anæsthesia special effort must be made to maintain a free air passage. At this period many patients have a spasm of the masseter (maxillary) muscles with resulting closure of the jaws. During this stage of excitement, a slight twist of the head also may cause interference with breathing. Never “push” chloroform anæsthesia. If the patient will not relax under this drug, change to ether until the stage of relaxation supervenes and then return to chloroform if it is deemed desirable to do so. If the drug has been administered properly, the stage of excitement should not occur, although it is frequently difficult with alcoholic or athletic patients to induce anæsthesia without a conspicuous stage of excitement. An open air passage and absolute silence in the room during the induction period will enable the anæsthetist to carry his patient successfully to the third or surgical stage of anæsthesia. The pulse is most important in chloroform anæsthesia; a pulse below 50 and extreme pallor are danger signals for the circulation. In full surgical anæsthesia, the pulse should be full and regular; any change in fullness or rhythm should be a warning to the anæsthetist. An increase in volume and rhythm indicates returning consciousness; a running pulse indicates shock; and an irregular pulse means danger. Respiration should be full and regular. Shallow respiration indicates failing circulation, shock, or may occur just before vomiting. Stimulation of the respiration may be brought about by adding a few drops of ether to the

mask, an occasional drop of aromatic spirit of ammonia, or by rubbing the lips with a piece of gauze or a towel.

Closed method.—As hospital corpsmen rarely will be called upon to administer chloroform by this method, no description of its use will be given here.

Ethyl chloride.

Ethyl chloride is a colorless, mobile, highly volatile, exceedingly inflammable liquid at low temperatures, possessing a sweet taste and a pungent fragrant odor.

Although ethyl chloride is employed occasionally as a general anæsthetic agent, its use for such a purpose in the Navy is not general. The duration of the anæsthesia is exceedingly brief and a continuous safe narcosis is not easily maintained. Its usefulness as a general anæsthetic is more or less limited to minor operations which do not require prolonged anæsthesia. As the administration of this agent requires the services of an expert anæsthetist, further details regarding its use in general anæsthesia will be omitted.

Nitrous oxide.

Nitrous oxide is a colorless transparent gas slightly heavier than air, with a sweetish taste and practically odorless.

When used alone without oxygen, it produces a state of anoxæmia (asphyxia), with loss of consciousness and sensibility to pain. Its usefulness under such conditions is limited to operations requiring little time for their completion.

Combined with oxygen in certain proportions, nitrous oxide now is recognized as one of the important and most useful anæsthetic agents for prolonged major operations as well as for dental operations and those of a minor character. The rapidity with which unconsciousness supervenes and consciousness returns, and the absence of unpleasant concurrent effects such as occur with ether and chloroform, make this drug an ideal anæsthetic agent. Its use, however, requires special apparatus, which therefore limits the employment of this drug for major operations to hospital practice where the services of a specialist in anæsthesia are available. No further details regarding its administration will be given here.

Combinations and sequences of various anæsthetic agents.

Various factors and conditions frequently require either combinations or sequences of the anæsthetic agents described in the foregoing pages. Numerous attempts have been made to create an ideal agent for general anæsthesia by the admixture of various agents. The most important and most useful of these mixtures are the combinations of chloroform and ether, either alone or with alcohol in varying proportions. The A C E mixture, composed of one part absolute alcohol, two parts chloroform, and three parts ether by volume, has been extensively used and has proven to be nearly twice as safe as chloroform alone. A freshly prepared mixture of two parts of chloroform and three parts ether is very easy to prepare and may be used by the drop method. It follows the general course of anæsthesia, described above in the sections on ether and chloroform, and may be considered a very satisfactory anæsthetic for most cases.

In hospitals where the nitrous oxide apparatus is available it is not unusual to employ that drug to induce unconsciousness. When this stage has been

reached, either ether or chloroform, usually the former, is admitted very slowly to the gas chamber of the apparatus until the patient is fully under the effects of the second drug, at which time the nitrous oxide may be discontinued.

In prolonged operations it is frequently desirable to limit the total amount of ether or chloroform employed. In such cases, recourse is had to the substitutions of the ether or chloroform by nitrous oxide. By instituting nitrous oxide anaesthesia in this manner a comparatively nonpoisonous anaesthetic replaces a poisonous one at a time when a stronger anaesthetic is capable of doing the most damage.

It is occasionally necessary or advisable for various reasons to change from ether to chloroform or vice versa during an operation. Should this be necessary little difficulty will be experienced provided the anaesthetist has a complete knowledge of his patient's condition at all times during the course of the anaesthesia.

Treatment of emergencies.

While every effort should be made to prevent the occurrence of emergencies, it is nevertheless true that, even in the hand of the most expert anaesthetists, various crises may occur which require immediate treatment. These emergencies or crises may be grouped under two headings, those due to respiratory failure and those due to circulatory failure. Reference already has been made to certain causes of respiratory obstruction and the indicated remedial measures have been discussed. The main effort in cases of respiratory failure should be directed toward clearance of the air passage and maintenance of the act of respiration. If the latter be not voluntary, artificial respiration is indicated. Regular pressure on the chest, drawing the tongue forward and lowering the head usually will restore normal breathing. If this procedure fails, it may be necessary to perform artificial respiration in accordance with the Sylvester method. Large amounts of fluid in the abdominal and pleural cavities may be the cause of respiratory embarrassment, and measures directed toward at least partial removal of these causes should be instituted.

The loss of the pupillary and corneal lid reflexes, associated with feeble respiration and increasing cyanosis, indicates paralysis of the respiratory center in the medulla. A hypodermic injection of atropine sulphate should be given immediately and artificial respiration instituted and continued until normal breathing is resumed. Anaemia of the brain, due to extensive haemorrhage or to chloroform, is counteracted by lowering the head and raising the lower limbs if necessary.

Circulatory failure recognized by a running, feeble, or irregular pulse, increasing pallor, and feeble respirations must be overcome by stimulation of respiration as indicated above and by the administration hypodermically of cardiac stimulants (caffeine, brandy, etc.).

Any change in the general condition of the patient should be communicated immediately to the operating surgeon. The latter depends upon the anaesthetist to inform him concerning the progress of the anaesthesia, and the anaesthetist should not hesitate to institute whatever measures are indicated to promote a successful anaesthesia.

Care of the patient after operation.

Transportation to bed.—In transporting the patient from the operating room to his bed, care should be taken that he is well covered with blankets. Unless

other instructions have been issued it is also desirable to have the head slightly lower than the rest of the body in order that proper circulation of the brain may be maintained and also that secretions from the mouth or, in case of vomiting, foreign material may not enter the trachea and lungs.

The bed, as described in another chapter, should be prepared for the patient in advance, care being taken to remove all hot-water bottles or electric heating apparatus, which should not be replaced until the patient has regained consciousness. A liberal supply of blankets will be all that is necessary to maintain the proper temperature. Until the patient is conscious, it is the principal duty of the attendant to maintain a free air passage. Removal of excess mucus from the mouth and throat may be aided by turning the patient's head to one side, thus permitting proper drainage. (Fig. 107.) The same maneuver is necessary when the patient vomits, as inhalation of particles of vomitus is probably one of the most frequent causes of post-operative pneumonia. As the patient approaches consciousness he is likely to become restless and will frequently attempt to interfere with the surgical dressings. He is also likely



FIG. 107. —Recovering from anæsthetic. Supporting jaw of unconscious patient. Head turned to side; no pillow; towel to protect bedding; additional light blanket thrown over the bed for added warmth. On the table are shown hypodermic, glass of sterile water, sponges, towels, and vomitus basin. (Warnshuis.)

to expose himself to chilling by removing what appears to him to be excessive bed covering. After certain types of operations, special arrangements of the bed are indicated. Among the most important of these is the so-called *Fowler's* position. A description of this position will be found elsewhere. It is mentioned here because it is sometimes difficult to maintain a patient properly in this position. In fact, unless care be taken, the patient will be found to have slid down from his proper place to the foot of the bed.

Opinions differ regarding the administration of fluids by mouth following general anæsthesia, and particularly following abdominal operations. It is therefore a safe rule never to give any fluids unless definite instructions have been received from the medical officer, whose advice always should be sought regarding all treatment.

LOCAL AND REGIONAL ANÆSTHESIA.

In the past few years notable advances have been made in the employment of local anæsthesia. It is not unusual at the present time to perform extensive major operations under local or regional anæsthesia. In many cases it is purely a matter of choice, while in others it is one of necessity.

As the duties of a hospital corpsman do not contemplate the employment of narcotic agents in the absence of a medical officer, and as the actual administration of local anæsthesia is performed practically always by the operating surgeon, the various methods of administration will not be discussed here.

Local anæsthesia may be produced by physical means as well as by drugs. The physical agents are pressure, rarely used by itself in this enlightened age, and cold. Freezing causes loss of sensibility to pain. The most common method of attaining local anæsthesia through freezing is the employment of the ethyl chloride spray, which is such a common occurrence that no further mention of its use need be made here. One insanitary, totally uncalled for, nonsurgical practice in connection with the use of ethyl chloride spray is the all too frequent habit of blowing the breath upon the operative area to hasten freezing. This is a practice which deserves the most severe condemnation for obvious reasons.

Local anæsthesia through the physiological action of certain drugs has been employed for many years. Various drugs have been used for this purpose, but few are efficient and many have been discarded after brief and unsatisfactory trials.

The most common drugs now used are cocaine, novocaine (procaine), and quinine and urea hydrochloride. Mention also should be made of eucaine, and various other substitutes for cocaine, which have become popular because of their lesser toxicity.

In the preparation of solutions of cocaine and novocaine it is the usual practice to introduce a certain percentage of adrenalin and to employ physiological salt solution as the solvent of the drug. The use of adrenalin is based upon its action upon the blood vessels (vaso-constriction), which, by constriction of the vessel walls, causes local ischæmia (deficiency of blood supply), an effect similar to that produced by cold and pressure, and also by hindering absorption, acts as a safeguard against poisoning. By lessening the tendency to hæmorrhage it also aids the surgeon in maintaining a dry field of operation.

Physiological salt solution (0.85 per cent) is employed as a solvent because it is a so-called isotonic solution, in that it has the same specific gravity and the same freezing point as the tissue fluids. Fluids of greater or less osmotic tension cause pain by drawing water from the tissues or by causing them to swell. Physiological salt solution does not injure the tissues and therefore does not retard recovery.

In the preparation and sterilization of cocaine solutions for hypodermic use it is essential to remember that they are chemically unstable and do not stand repeated or prolonged boiling.

There are several methods used in the sterilization of cocaine solutions. Solutions of cocaine, minus the adrenalin, may be boiled just before use and the adrenalin added drop by drop. Cocaine solutions also stand sterilization in the autoclave fairly well (20 minutes at 115° to 120° C.) and if corked immediately afterwards will be efficient for a long time. Cocaine and adrenalin also may be obtained in tablet form and may be sterilized in that form by dry heat at 80° C. for one hour on three successive days. The solution is prepared

by dissolving the tablet in sterile physiological salt solution. Cocaine commonly is employed in 0.1 per cent and 1 per cent solutions.

Novocaine is recognized now as the safest of the local anæsthetics. It will stand boiling and its solutions will keep for a long time. Adrenalin increases and prolongs the action of novocaine. These two drugs in combination are also prepared in the form of a tablet, ready for solution in physiological salt solution. Novocaine is much slower in its action than cocaine. It is commonly employed in 0.5 to 1 per cent solutions.

Quinine and urea hydrochloride causes rapid anæsthesia of prolonged duration and is said to be practically nontoxic. For application to mucous membranes a 10 to 20 per cent solution is used; for injection purposes the strength of the solution is usually 0.5 to 1 per cent.

Preparation of the patient.

For extensive operations under local or regional anæsthesia, the preparation of the patient will, in general, follow the same rules previously described under general anæsthesia.

For minor operations, it is usually unnecessary to prescribe any special preparation, although it is advisable for the patient to refrain from partaking of a heavy meal and to observe special care regarding normal movements of the bowels.

The local preparation of the operative area will depend upon the personal wishes and technique of the operating surgeon, whose advice should be sought before any local preparation is begun.

Overdosage and poisoning from cocaine.

The safe average dose of cocaine is about three-fourths grain, but this varies within wide limits. Less than this amount frequently will produce toxic symptoms if thrown into the circulation too rapidly in susceptible individuals. On the contrary, many times this amount may be given when well diluted and when absorption is retarded.

The age and condition of the patient is an important factor in cocaine poisoning. Young people, due to their highly sensitive nervous system, are usually more susceptible than adults.

The symptoms usually are grouped into two stages, excitation and paralysis. The symptoms of mild intoxication are loquacity, laughing, singing, and later nausea, vertigo, faintness, and thoracic oppression.

The more severe symptoms are rapid and weak pulse, oppressed or rapid respiration, mental excitement and anxiety, restlessness with twitching of the muscles. At times there may ensue violent delirium, convulsions, and unconsciousness ending in death. During the early stage the pupils usually are dilated, but may be contracted at times. Occasionally the stage of excitement is entirely absent.

Treatment.—Place the patient in a horizontal position with the head lowered; fresh air; for the weakened circulation give ammonia by inhalation and cardiac stimulants hypodermically; for the convulsions, either ether or chloroform (preferably the former) may be employed. Should respiration cease it is necessary to resort to artificial respiration.

SPINAL ANÆSTHESIA.

Although this method of producing surgical anæsthesia is not within the province of the hospital corpsman, it is desirable that he understand the general principles underlying the procedure.

The introduction of anæsthetic agents into the spinal canal causes an extensive blocking of the nerves at the site of injection and anæsthesia of all the parts to which these nerves are distributed.

The agents most frequently employed are solutions of tropococaine, stovaine, and novocaine. The last is considered by many surgeons to be the safest of all anæsthetics for use in spinal anæsthesia. In the preparation of the patient the hospital corpsman will be guided by instructions received from the medical officer. In general, it is customary to prepare the patient in the same manner as described in the section devoted to general anæsthesia. Locally, it is necessary to prepare the site of injection as well as the area of operation.

Occasionally patients show alarming symptoms of respiratory or circulatory failure. It is therefore essential that an emergency tray be at hand containing sterile hypodermic syringes, needles, and solutions of atropine sulphate, caffeine sodium-benzoate, strychnine, and if possible either brandy or its present-day substitute, ethyl alcohol.

During the entire course of the operation the anæsthetist should engage the patient in conversation, not only to divert the attention but to increase activity of the brain. Questions by the anæsthetist requiring extensive answers from the patient aid the latter's respiration. If there is a tendency to nausea, the application of cold wet sponges on the lips, forehead, and neck is grateful to the patient and aids in the checking of nausea and vomiting.

After treatment.—As the patient is conscious the ordinary routine directions regarding the air passages are not required in these cases. Nausea frequently occurs, however, and while not troublesome in itself, may cause complications following abdominal operations. Application of cold as described above frequently relieves this distressing condition.

Respiratory failure is not frequent, but when it occurs it requires active stimulation and, if necessary, artificial respiration.

Headache is a very frequent and annoying sequel of operations under this type of anæsthesia. It usually can be controlled by ice bag and aspirin, the patient being kept flat in bed. Vomiting may be controlled as described under treatment of nausea. If such methods do not produce favorable results, gastric lavage is usually successful.

Retention of urine may occur and is relieved by catheterization. Fortunately this unpleasant complication is neither frequent nor of long duration.

Diet.—The conditions requiring the operation and the type of operation itself naturally determine the type, quantity, and quality of diet. It is always safe to withhold all food and fluids until special instructions concerning them are received from the medical officer.

REFERENCES.

- Barber.—Nitrous Oxide.
- Barton.—Administration of Ethyl Chloride.
- Blumfield.—Anæsthetics.
- Boyle.—Anæsthetics.
- Braun.—Local Anæsthesia.
- Crandon and Ehrenfried.—Surgical After-Treatment.
- Da Costa.—Surgery.
- Gardner.—Anæsthesia.
- Gwathmey.—Anæsthesia.
- Hewitt.—Anæsthetics.
- Labat.—Regional Anæsthesia.
- Luke.—Guide to Anæsthetists.
- Magaw, Alice.—"A Review of Over Fourteen Thousand Surgical Anæsthesias," Surg. Gyn. and Obst., Dec., 1906.
- Mortimer.—Anæsthesia and Analgesia.
- Patton.—Anæsthetics.
- Turnbull.—Anæsthesia.
- Williams.—Anæsthesia.

Physiotherapy.¹

Physiotherapy is the application of physical remedies in the treatment of diseases and injuries. In most hospitals and clinics it includes massage, medical gymnastics, hydrotherapy, radiant heat, and light therapy and electrotherapy.

MASSAGE.

Massage is the therapeutic manipulation of soft tissues in the form of stroking (*effleurage*), rubbing (*friction*), kneading (*petrissage*), hacking, clapping, beating, and vibration (*tapotement*). The fingers and hands generally are used to perform these manipulations, and the fingers and hands of the operator should be clean and warm. To prevent causing unnecessary discomfort or pain to the patient the use of a lubricant such as cocoa butter, a bland oil, or an appropriate liniment is necessary.

The manipulations of massage.

Effleurage (fig. 108) is given to assist the circulation of blood and lymph. The strokings are therefore always toward the heart and most commonly



FIG. 108.—*Effleurage* of arm.

over veins and lymph vessels that easily can be affected, as in front of the neck by strokes from the chin to the clavicles, and in the extremities, by long strokes from the wrist to the shoulder, and from the foot to the fold of the groin. It also is used frequently to relieve local congestion, as for example, in a recent sprain, when light *effleurage* will bring on a visible reduction of the swelling with marked relief. The strokings are performed with the flat hand, a portion of the hand, or with the thumb and forefinger, depending upon the size of the part to be treated.

¹ Prepared by Lieut. E. G. Hakansson, Medical Corps, United States Navy.

Friction (fig. 109) is a rubbing with pressure and is used chiefly to break up old inflammatory products, such as the fibrosis in a stiff joint or an adherent scar. To accomplish this, the rubbing must be done with considerable pressure, often to the point of causing some pain. It is performed with the thumb or three middle fingers or with the whole palm of the hand. Friction should be followed by effleurage to relieve the congestion produced and to promote an active circulation.

Petrissage (fig. 110) consists of a kneading of the muscles and other deep tissues to promote normal metabolism, or to favor absorption of inflammatory products. It is performed either with the whole of the palmar surface of the hand or with fingers and thumb, depending on the size of the muscle or mass treated.

Tapotement (fig. 111) consists of a series of gentle blows, one following another in rapid succession. The effect is essentially a mechanical stimulation



FIG. 109.—Friction of knee-joint.

of muscles and nerves. It is performed in various ways; hacking across the muscles with the ulnar borders of the hands; clapping with a slightly cupped hand, used for large surfaces such as the back and chest; tapping with the finger tips for small areas; beating with the ulnar border of the closed hand for large thick muscle groups such as the gluteal muscles; and vibration, best performed by mechanical vibrators.

General massage is used mostly as a substitute for physical exercise when it can not be taken, as, for instance, when a chronic illness confines a patient to bed. The greater part of the body is treated; first the hand, forearm, arm and shoulder on each side; then the foot, leg, and thigh on each side; then the abdomen, and finally the back and gluteal regions. Each part, except the abdomen, which is treated according to the method described below, is given effleurage, petrissage, tapotement, and then effleurage again as a finishing manipulation. All manipulations should be performed with only moderate

strength and without causing discomfort to the patient. The treatment should take about 45 minutes, 15 minutes of which should be set aside for the abdominal massage.

Abdominal massage (fig. 112) is given most frequently for chronic constipation due to laxity of the musculature of the intestines. It is also useful as a means of aiding the absorption of foodstuffs from the alimentary canal. Better digestion and improved appetite frequently result from this treatment. It is performed mainly as small circular manipulations with steady pressure aiming at a kneading of the alimentary canal between the anterior and posterior



FIG. 110.—Petrissage of forearm.

abdominal walls. This manipulation is best performed by the palmar surfaces of the three middle fingers on hyperextension. Attempts are made to manipulate all parts of the alimentary canal; first the stomach in the epigastric region, next the small intestines in the umbilical region, and lastly the colon, beginning over the cæcum, and the sigmoid flexure down to the symphysis pubis. This procedure will result in rubbing every half inch of the colon that can be reached. The treatment should be concluded by strokings over the transverse and descending colon and the sigmoid flexure to empty the contents into the rectum. It should be remembered in this connection that the important effect of the abdominal massage is not the forcing onward of the contents, but the mechanical stimulation by the kneading of the muscles in the walls of the alimentary canal. The treatment should occupy at least 15 minutes and should be given daily, or in obstinate cases of constipation, twice daily. Good results usually are obtained after two weeks treatment, but in many cases several months of treatment are required.



FIG. 111.—Tapotement of back.



FIG. 112.—Abdominal massage.

Contraindications to massage.—Massage is contraindicated in many skin lesions, particularly those of an infectious nature; some diseases and changes in the blood vessels, such as aneurism, varicocisities, and phlebitis; when there is danger of hæmorrhage as in hæmophilia, leukaemia, purpura, and scurvy; and in the vicinity of foreign bodies. Because of the danger of spreading disease, massage can not be given near purulent processes, tuberculous lesions, and malignant tumors. Abdominal massage must not be given in the presence of acute inflammatory conditions in or adjacent to the peritoneal cavity, such as appendicitis, ulcers of the stomach, and ulcers of the intestines.

Some general rules for massage.—The patient should be in a comfortable position and in as complete muscular relaxation as possible. To obtain relaxation, support of the part to be treated is necessary.

The operator should choose a position which will allow him to efficiently perform his work and, at the same time, one which will call for no unnecessary exertion. It is imperative that the hands be thoroughly washed before and after administering treatments.

MEDICAL GYMNASTICS.

Medical gymnastics, also called therapeutic exercises, corrective gymnastics, Swedish movements, muscle training, and other similar names, is a systematic exercise of the motor apparatus of the body applied in the treatment of disease and deformities.

The main parts of the motor apparatus are: The skeletal muscles, the bones, the joints, the motor nerves, and the sensory nerves which convey deep impressions from muscles and joints. These, then, are the tools in medical gymnastics and the work performed with these tools consists of changes in positions and movements.

Starting positions.—In order that the movements may be performed in a uniform manner and have a definite effect, it is essential that they be given from certain positions, called starting positions. These starting positions are classed as *fundamental* and *derived* positions. The five fundamental positions are:

1. *Standing* (fig. 113).—Heels together, feet at about an angle of 70° to each other, knees fully extended, trunk erect, abdomen drawn in tightly, shoulders lowered and flattened out at the back, head erect with chin slightly drawn in, arms close to the sides, and all joints extended.

2. *Knee-standing* (fig. 114).—Most commonly used on a table with the feet beyond the edge. The body on the knees, which should be together; the position otherwise is the same as the standing position.

3. *Sitting* (fig. 115).—Taken on a chair or a stool. The body rests chiefly on the tuberosities of the ischium, but the thighs should be supported and the feet rest on the floor. The hip, knee, and ankle joints should form right angles. The positions of the head, trunk, and arms are the same as in the standing position.



FIG. 113.—Standing fundamental position.

4. *Lying* (fig. 116).—The body is stretched out on a horizontal surface, arms at the sides, muscles relaxed.

5. *Hanging*.—Taken on a horizontal bar or similar apparatus. The hands over-grasp or under-grasp the bar at shoulders breadth. The arms, trunk,



FIG. 114.—Knee-standing fundamental position.



FIG. 115.—Sitting fundamental position.

and legs are held straight, and the head is carried slightly back. The body must not hang too slack; the muscles must work to such an extent as to avoid too strong stretching of ligaments and capsules.

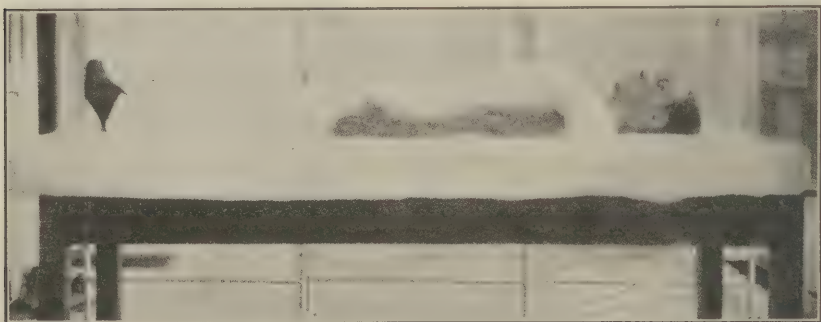


FIG. 116.—Lying fundamental position.

Derived positions are obtained from each of the above *fundamental positions* by changing the position of (1) the legs, (2) the arms, (3) the trunk, and (4) by various combinations of these positions. In this way an almost endless number of positions may be obtained.

Following is a short description of some of the more commonly used derived positions, showing their muscular mechanism and the effects and uses.

Positions which are derived from the fundamental standing position are:

(a) By changing the position of the legs, consisting of *fall-out-standing* (Fig. 117): In this position one foot is moved about three foot lengths straight forward or backward, at the same time the body falls forward and the front knee is bent to a point in a vertical line with the toes; the trunk and the fully extended posterior leg must be in a straight line (to take up and maintain this position a larger number of muscles are brought into action, especially the back muscles, and more particularly those of the lumbar region on the side opposite to the posterior leg. This position therefore is used to correct a lateral curve of the spine with the convexity on the opposite side to the posterior leg); *toe-standing*: Heels raised as high as possible from the ground and kept in contact with each other; *knee-bend-standing*: Knees flexed to right angle and separated; *walk-standing*: One foot moved forward about two foot lengths; and *stride-standing*: One foot moved two foot lengths to one side.

(b) By changing the position of the arms, consisting of: *Yard-standing* (fig. 118), in which the arms are abducted to the horizontal plane and carried back in line with the shoulders, the shoulders kept lowered and drawn back, hand and finger joints extended, palms turned down, and the fingers closed (the working muscles are the deltoid, trapezius, and serratus magnus, and the principal effect is an expansion of the thorax and a strengthening of the posterior shoulder muscles, which must be held in complete contraction to fix the shoulder blades during the movement. The position therefore is used in the treatment of flat chest and "winged" shoulders); *hips-firm-standing*: Hands placed on the hips with fingers forward and thumb backward; *neck-firm-standing*: Hands carried up to the back of the neck, finger tips touching, elbows well back, head high; *reach-standing*: Arms brought forward to a level with the shoulders, width of shoulders apart, palms facing each other; *bend-standing*: Flexion in elbow joints as far as possible, elbows close to the sides, shoulders lowered and drawn back; and *stretch-standing*: Arms in complete extension overhead, carried well back, palms facing each other.



FIG. 117.—Fall-out-standing.

(c) By changing the position of the trunk, consisting of: *Turn-standing* (Fig. 119); Trunk rotated to one side as far as possible, the pelvis taking part in the



FIG. 118.—Yard standing.

rotation, head and shoulders not rotating (the chief effects are exercise of the rotator muscles of the trunk and pelvis, and increased mobility of the ribs and joints of the spine); *stoop-standing*: Forward bending, chiefly at the hip joint, to a right angle between trunk and thigh, spine and legs kept straight; *lax-stoop-standing*: Forward and downward bending of the body at hip joints and in lumbar spine, knees fully extended; *arch-standing*: Trunk bent backward with as much movement as possible in the dorsal region; and *side-bend-standing*: Trunk bent directly to the side.

(d) By combination, consisting of various combinations of above positions which are valu-

able and frequently used, for example: *Hip-firm-stoop-standing*; *stretch-stride-arch-standing*; and *stretch-fall-out-standing*.

2. A number of positions may be derived from the fundamental knee-standing position in the same manner as from the standing. In medical gymnastics the following are used: *Hips-firm-stride-knee-standing*; *neck-firm-stride-knee-standing*; *stretch-stride-knee-standing*; *hips-firm-arch-stride-knee-standing*; *neck-firm-arch-stride-knee-standing*; and *stretch-arch-stride-knee-standing*.

3. The following positions may be derived from the fundamental sitting position: (a) By changing the position of the arms, *hips-firm-sitting*; *neck-firm-sitting*; *reach-sitting*; and *stretch-sitting*. These positions arise in the same way as the corresponding positions derived from the standing positions.

(b) By changing the position of the legs: *Stride-sitting* (feet placed two foot lengths apart); and *ride-sitting* (patient sits astride a bench or a chair).

(c) By changing the position of the trunk: *Arch-sitting*; *stoop-sitting*; and *turn-sitting* (these are similar to the corresponding positions derived from the fundamental standing positions); *fall-standing* (backward falling of the trunk, knees or feet supported), a position much used for the exercise of abdominal muscles; and *spring-sitting*, a position similar to the fall-out-standing except that the



FIG. 119.—Turn standing.

anterior thigh rests on a stool (used in various combinations for spinal curvatures).

(d) By combination: *Hips-firm-ride-sitting*; and *stretch-stoop-stride sitting* are two of the most commonly used in this group.

4. The following positions may be derived from the fundamental lying position:

(a) By changing the position of the arms: *Hips-firm-lying*; *neck-firm-lying*; and *stretch-lying*.



FIG. 120.—Leg-forward-lying.

(b) By changing the position of the legs: *Stride-lying*; and *sit-lying*; (legs hang freely down beyond the edge of a bench).

(c) By changing the position of the trunk: *Half-lying* (a position halfway between the sitting and lying positions as when seated in a Morris chair) is



FIG. 121.—Arch-leg-side-lying.

restful, requires the use of no muscles, and is recommended for weak patients; *forward-lying* (patient lies face down on a bench or bed); *leg-forward-lying* (Fig. 120), (patient lies face down on a bench, with only the legs resting on it while the trunk lies beyond the edge of the bench, the feet and legs being fixed by a strap or held by an assistant); *arch-leg-forward-lying* (same as the preceding position with a bending backward of the spine); *leg-side-lying*; and *arch-leg-side-lying* (fig. 121), corresponding to the last two positions with the

patient lying on one side. These four leg-lying positions are much used in the gymnastic treatment of spinal curvatures.

5. The most important position derived from the fundamental hanging position is *arch-hanging*. In this position the bar should be at the height of the patient's head or chest, legs moved back and supported by tips of toes on the floor, body lowered until it hangs in an arch, elbows and knee joints fully extended (used in treating kyphosis).

Movements.—For the purpose of medical gymnastics movements may be classed as: *Active movements* which are performed by the patient himself; and *passive movements* which are performed in the patient's joint by some outside force (a person or an apparatus) and without any muscular effort on the part of the patient.

Active movements are further divided into: *Free movements*, performed by the patient himself without any assistance; and *resistance movements*, performed with the cooperation of an operator. Resistance movements are either *concentric* or *eccentric*. In the concentric movement the working muscles are shortened; for example, in flexion of the elbow against resistance the flexors work concentrically. In the eccentric movement the working muscles are lengthened; for example, the flexors work eccentrically in the extension of the flexed elbow by the operator while the patient resists the movement.

Movements of the various joints and appropriate starting positions.—The various starting positions and the different kinds of movements above described furnish a system for prescribing exercises of well-defined effects for any part of the motor apparatus and for any degree of disability for which medical gymnastics can be used. In order to prescribe the most effective movements and avoid harmful results it is necessary to have a knowledge not only of the mechanics and effects of the various movements, but also of the anatomy and physiology of the human body and the nature of the disability to be treated. It therefore must be left to the medical officers or persons who have made a special study of this subject to prescribe the proper remedial exercises.

The duty of hospital corpsmen in this regard is to administer the movements prescribed. Practical training is necessary in order that this work may be carried out in an efficient manner. A fair understanding of the subject can be obtained by giving or taking the different types of movements (passive, free active, resistance, concentric, and eccentric) in the various joints from several starting positions. As a guide, some of the most commonly used movements will be enumerated.

1. Movements in the ankle joint, consisting of: Half-lying foot-bending and stretching; free-standing foot-bending and stretching (alternate toe and heel raising); half-lying and sitting, with foot-rolling; and sitting with foot-inversion and eversion.

2. Movements in the knee joint, consisting of: Half-lying, sitting, and forward-lying with knee-bending and stretching.

3. Movements in the hip joint, consisting of:

(a) For flexor muscles of the hip joint, hip-firm alternate knee raising; lying, knee-updrawing and down-pressing; lying, and stretch-lying with leg-lifting and down-pressing.

(b) Combined flexion in hip and knee joints, consisting of stretch-grasp-lying, leg-updrawing and down-pressing.

(c) For extensor muscles of hip joint, consisting of back-lean-standing, leg-forward-drawing, and backward-carrying.

(d) Combined extension in the hip and knee joints, consisting of half-lying, leg-out-stretching.

(e) Combined extension in the hip, knee, and ankle joints, consisting of hips-firm-standing, heel-raising knee-bending.

(f) Movements for the adductor muscles of the hip joint, consisting of crook-half-lying, knee-parting and in-pressing.

(g) Movements for the adductor muscles of the hip joint, consisting of crook-half-lying, knee-closing and out-drawing.

(h) Movements for the rotator muscles of the hip joint, consisting of half-lying, leg-rotation.

4. Movements in the wrist joint, consisting of sitting, wrist-bending and stretching; and sitting, wrist-rolling.

5. Movements in the elbow joint, consisting of sitting, fore-arm-rotation; and sitting, forearm-bending and stretching.

6. Movements in the shoulder joint, consisting of standing, arm-lifting-side-ways; standing, arm-lifting-forward; yard-standing, arm-rolling; stretch-lying, arm-bending and stretching; and stretch-stoop-stride-sitting, arm-bending and stretching.

7. Head and neck movements, consisting of arch-hanging neck-raising; standing, head-side-bending and raising; lying, head-rotation; and hips-firm-standing, head-rolling.

8. Trunk movements, consisting of; hips-firm-ride-sitting, trunk-backward-drawing and raising; stretch-knee-stride-standing, backward-drawing and raising; neck-firm side-bending and raising; yard-standing, alternate trunk-turning; and hips-firm-stride-standing, trunk-rolling.

General rules for giving movements.

1. Movements as a rule should be taken to the full extent.

2. At the limit a little overstretching is given to increase the range of movement.

3. In resistance movements the resistance must be given from the very beginning to the end of the movement.

4. Resistance must be regulated carefully according to the strength of the patient. Shaking or unevenness of the movement shows that the resistance is too strong.

5. Respiratory exercises and most trunk exercises must be given in time with the breathing. Movements of the extremities may be given more quickly.

6. The patient must breathe freely throughout the movement.

7. The operator should take a suitable position so that he can give the exercise firmly and continuously.

8. All grasps must be with a flexible hand, firm, but not pinching.

General effects of movements.

1. The blood supply of the working muscles is increased.

2. Because of this increased supply of blood to the working muscles, the amount of blood in the other parts of the body is diminished. By strong leg movements it is possible to remove congestion in the head.

3. By continued exercise the muscles become larger and stronger.

4. The mobility of the joints is increased, especially if the movements are taken to the extreme limit.

5. The heart action becomes stronger to meet the demand for more blood in the working muscles.

6. The circulation in the veins is assisted in several ways: (a) The contracting muscles as they thicken press upon the veins in the vicinity and force the contents onward toward the heart; and (b) with the alternate lengthen-

ing and shortening of the veins that pass over the moving joints, there is an alternate increase and diminution of capacity resulting in a pumping of the blood toward the heart.

7. Respiratory activity is increased to meet the increased need of oxygen. This leads to better expansion of the chest and improved circulation and ventilation of the lung.

The above effects occur particularly during active movements. Passive movements have similar effects, but to a very much less degree.

HYDROTHERAPY.

Hydrotherapy is the treatment of diseases and disabilities by baths, packs, compresses, and other forms of water applications to the skin.

In the physiology of the skin are several points of importance in hydrotherapy. The outer layer of the skin, the epidermis, is practically a waterproof covering. Under this lies the true skin with networks of blood vessels



FIG. 122.—Ablution.

and nerves. Deeper in are the sebaceous glands and the sweat glands. With these various structures the skin performs important functions in the maintenance of life. The regulation of the body temperature is done mainly through the skin, and this function is of particular interest to hydrotherapy. When the body is exposed to heat the sweat glands pour out their secretion, the evaporation of which cools the body surface. At the same time the skin capillaries dilate, allowing a large amount of blood to circulate at the surface and be cooled off. When the body is exposed to cold the perspiration is checked almost completely and the capillaries are contracted, thus permitting only a small amount of blood to come to the cold surface. Only a healthy skin, a skin with blood vessels and sweat glands that respond promptly and effectively to temperature variations, can perform this function satisfactorily. In hydrotherapy, as later will be explained, we have the means of keeping a skin active and ready to respond to temperature changes.

Another physiological condition of importance in hydrotherapy is the reflex connections between the nerves of the skin and the nerves that control various vital functions, such as respiration, heart action, muscular tension, and tissue metabolism. An evidence of these connections is the familiar effect on the

respiration of a sudden application of cold water to the chest, abdomen, or back, as when a towel wrung out in cold water is slapped on one of these parts or when one steps under a cold shower. First, there is a momentary suspension of respiration, then a deep gasp followed by regular and full respiration. Through these reflexes it becomes possible to stimulate or depress many important functions in the body by hydrotherapeutic applications. These effects will be referred to further in the discussion of the various baths and packs.

The hydrotherapeutic reaction.—In hydrotherapy the reaction is a very important feature. In brief, the reaction is the response of the patient to a cold application. The reaction is just the opposite to the first effect of cold.

First effect of cold.

1. Contraction of blood vessels of the skin; quickened pulse.
2. The skin becomes pallid and "gooseflesh" appears; perspiration is checked.
3. Respiration is momentarily checked, then becomes quick, deep, and gasping.
4. Shivering, chattering of teeth, sensation of chilliness and distress.

Reaction.

1. Dilatation of the blood vessels of the skin; slowed pulse.
2. The skin "pinks up," a rapid current of aerated blood is flowing in the capillaries. The activity of sweat glands and sebaceous glands is increased and the skin becomes smooth and supple.
3. Respiration slower.
4. Sensation of warmth and a comfortable glow in the skin, a general feeling of well being; the muscles possess greater tone, and mental foggi-ness gives way to alertness.

The reaction usually sets in as soon as the cold is withdrawn, or in case the cold application is prolonged, within one or two minutes. People in good health react more quickly than those in impaired health. If the patient does not react, the application has been too much for the vital activities and it has done harm rather than good. Failure to react is shown by blueness of the lips and a pallid or blue, gooseflesh skin instead of a pink and smooth one. The patient has a chill and all the discomfort accompanying it.

If this occurs, or if the patient is slow in reacting, measures to favor the reaction must be applied, as follows:

1. Before the cold application the body and skin temperature may be raised by exercise (in the robust), electric-light baths, hot-air baths, and by hot drinks;
2. During the cold application by friction by attendant or by the patient himself;
3. After the application by friction with the hand or a warm towel, hot drinks, a warm room and warm coverings.

Technique of hydrotherapy.

An elaborate technique and a high degree of skill are not necessary for successful hydrotherapeutic applications, but careful attention to details and precision in the application are essential. The technique, effect, and uses of a few of the most valuable and most commonly used hydrotherapeutic applications are described.

Ablution (fig. 122).—A rubber sheet, a blanket and a sheet are spread on one side of the bed, one third hanging over the side and the third along the opposite edge rolled. Place a pail or tub filled with water near the bed. The patient is undressed but covered except on the parts to be treated. Freely apply water successively to arms (not forearms), chest, abdomen, and thighs, using the bare hand or a linen washcloth and accompany by friction and light clapping; then dry and replace the part under cover. In vigorous individuals with high fever, drying may be delayed until the ablution is completed. Give the first ablution at 85° F. and reduce the temperature 5° F. each time until 70° F. is reached. Repeat every two hours if the patient is awake and if the character of the fever so requires.

The ablution is a mild antifebrile application. In addition to the cooling effect, the friction and the impact of the water produce a refreshing reaction with a warm glow in the skin and a feeling of stimulation throughout the body. It is far superior to the commonly used sponging, which is merely an unpleas-



FIG. 123.—Sheet bath.

ant moistening of the skin, and apt to produce chilling, since no reaction is brought on.

Towel bath.—Place a linen towel wrung out of water at 80° F. to 70° F. successively over the chest, abdomen, back, arms, and thighs. Squeeze water at 70° to 60° F. from a sponge or the towel. Apply friction and patting with the flat hand over the wet towel.

This is another antifebrile application. It is more effective than the ablution. The cooling action can be regulated by (1) the temperature of the water, (2) the duration of the procedure, and (3) by the number of applications on each part.

Sheet bath (fig. 123).—Place a rubber sheet on the bed and on this a linen sheet wrung out of water at 80° to 90° F. Bathe the patient's head and face with ice water, wrap a cold towel-turban about his head, place him on the wet sheet and quickly wrap him, as follows: while he holds both arms up, the right third of the sheet is wrapped snugly around the body and the right leg and foot with the upper edge close under the arms. The arms now are brought down and the other part of the sheet is brought over the body, arms, and legs,

with the upper border around the shoulder and neck and the lower border tucked beneath the heels. The entire left edge is tucked under the neck and beneath the right side of the body. Now, with flat hands, give gentle friction and patting over the wet sheet. As soon as the sheet is heated up alternate the friction with the squeezing of cold water, 60° to 70° F., from a sponge over successive parts of the body. If the patient begins to shiver discontinue the cold water and give friction until he warms up again. The cooling effect may be increased by allowing the patient to remain in the sheet for half an hour, or longer if asleep, having first withdrawn the rubber sheet and wrapped him in a blanket.

The sheet bath is an efficient antifebrile application. It is more severe than the ablution and the towel bath, but milder than the cold friction bath (see below), for which it may form a substitute where the necessary facilities for such a bath can not be procured. In its effect on the body temperature, on the circulation, and other functions it is very similar to the cold friction bath.

Cold friction bath.—Fill a bathtub to three-fourths of its depth with water from 70° to 80° F. If the patient is acutely ill, as in typhoid fever, the tub should be near the patient's bed. The patient is given a small cup of hot coffee just before he is undressed. His face having been bathed with ice water, he is lifted into the bath and gently lowered. The head should be supported by a water cushion suspended from the head of the tub or it should be held by an attendant. Immediately after the submersion and during the whole bath gentle friction should be given to prevent chilling, cyanosis, and collapse. Every part of the body except the lower part of the abdomen should receive this friction. Several times during the bath, water at 60° F. is gently poured, from a basin, over the patient's head, the face being protected by a folded towel around the forehead. The duration of the bath is usually 15 minutes. Complaint of chilliness is no reason for discontinuing the bath unless there is, at the same time, a chattering of the teeth. Blueness of the face indicates an enfeebled heart action and is also a sign for immediate removal from the bath.

During the bath a double blanket and a sheet are spread on the bed, the pillow is covered with towels and several hot-water bags are placed at the feet.

When the bath is finished the patient is lifted out gently and placed in the prepared bed, quickly but carefully wrapped in the sheet and blanket and allowed to remain in them for 5 to 10 minutes. If, however, the patient's temperature was lower than 103° F. per rectum before the bath, or if there is decided chilliness after removal, the patient should be dried immediately before being wrapped in the sheet and blanket.

The cold friction bath is the well-known Brand bath for the treatment of typhoid fever. The beneficial effect of this procedure is due not only to the reduction of the temperature but also, and to a much greater extent, to that improvement in the circulation, respiration, mental condition, and muscle tone *which is a part of the hydrotherapeutic reaction*. With the aid of friction the skin capillaries dilate and a free flow of blood is permitted. At the same time the stimulation of the sensory nerves of the skin by the cold and the friction excites the heart to better contractions. This improves the circulation in all parts of the body, and the congestion of the internal organs is decreased. The hurried shallow respiration of the typhoid patient becomes deeper and slower. The flaccid muscles improve in tension in response to the cold and the improved circulation. The depression of the nervous system, drowsiness, and delirium give way to a calm and clear mind. A refreshing sleep often follows this bath.

Wet pack (fig. 124).—A bed sheet, a rubber sheet, and two large woolen blankets are spread upon a mattress in the order mentioned. Upon this is spread smoothly a sheet wrung out of water at 60° to 70° F. The patient is placed on this sheet and his arms are raised alongside his head. One-third of the sheet is drawn from left to right across the chest. The arms are lowered, the sheet intervening between them and the sides of the trunk, and the other two-thirds of the sheet are brought across the body, covering both arms. The lower part of the sheet is pressed between the thighs and legs and the lower border tucked under the heels avoiding tension on the toes. Each blanket now is wrapped separately and as tightly as is possible around the trunk and legs. The upper borders are reversed



FIG. 124.—Wet pack.

so as to get a close fit around the neck. Both sides are tucked under the body and drawn tight. The lower edge of the blanket next is gathered together and tucked beneath the heels. Lastly, the sheet is wrapped similarly and tucked in at the neck to prevent annoying irritation from the blankets. If the patient does not warm up, he may be covered with one or two additional blankets. A cold wet-towel turban is placed on his head, and this is changed several times in order to keep the head cool. The important points in the application of a wet pack are:

- (1) All parts of the skin surface must be in contact with the wet sheet.
- (2) There must be complete exclusion of air.
- (3) The blankets must be applied tight.

The duration of the pack should be from one-half to one hour and unless given for insomnia a needle douche or a fan douche should be given immediately upon removal. If given for insomnia, the pack should be applied in the

bed and the patient allowed to remain in the pack, if asleep. In case the patient complains of being too warm one of the blankets may be removed.

There is first the usual effect of cold. Within one to five minutes the reaction appears. The skin vessels dilate and the body surface begins to heat up. Loss of heat is inhibited by the enveloping blankets and the patient soon lies in a warm, moist, and soothing envelope. He becomes drowsy and sleepy and wants to be left alone. If prolonged for one hour, the wet sheet is heated above the normal body temperature, perspiration appears on the forehead, and the elimination from the skin is increased. The wet pack is used mostly for insomnia and restlessness in psychiatric patients. It is equally valuable for the excitement and delirium in acute febrile diseases. (Fig. 125.)

Hammock bath or continuous bath.—A bathtub designed especially for hammock baths is desirable. It should be provided with a thermostatic control



FIG. 125.—Wet pack, completed.

to insure an even temperature, an overflow drain in addition to the bottom drain, and a hammock that can be secured to the sides of the tub. The patient lies in the hammock completely submerged except the head. The tub should be covered with a blanket supported by light bars lying across the edges. The temperature of a hammock bath should be agreeable to the patient and somewhere between 90° and 100° F. The bath should be of short duration at first and gradually prolonged. It may be given continuously night and day for weeks and even months. If the patient can not sleep in the bath he should be removed to a bed at night. He also should be removed for urination and defecation, except when the patient's condition makes these interruptions undesirable, when these needs may be satisfied in the tub. To prevent puckering and peeling of the skin, the patient should be anointed with lanolin until the skin becomes used to the water. The constant presence of an attendant is required.

The hammock bath is very similar to the wet pack in its effect. The patient is in a neutral medium, which has a quieting effect. It is used mainly for the same purpose, to quiet restless and maniacal patients. It differs from the wet pack in that it furnishes very little restraint. A very much disturbed patient, therefore, can be treated with more success in a pack than in the hammock bath.

Fomentations.—A fomentation is a hot application. The most satisfactory material to use for the compresses is heavy flannel which is cut in sizes to fit the region to be treated. Four to six layers are usually needed. It is steeped in boiling water and then *thoroughly wrung out so that every drop of hot*



FIG. 126.—Whirlpool bath for arms.

water is expelled. A clothes wringer is most convenient for this purpose but a satisfactory wringer can be made of a crash towel and two strong sticks about 24 inches long, one secured to each end of the towel by stitching. The fomentation compress is placed in the towel, lowered into the boiling water, and then wrung out by twisting the towel by means of the sticks. It then is quickly carried to the patient and there taken out and placed on the part to be treated. If a clothes wringer is used, the fomentation compress is rolled as it comes out of the wringer and carried to the patient in a piece of dry flannel or a towel. If the patient complains of burning, pass the hand once or twice between the skin and the fomentation. This will remove any drops of hot water that may have formed and at the same time cool the flannel. If the fomentation compress has been wrung out completely there is but little danger of a burn. It is well, however, not to apply the fomentation too hot at the begin-

ning. The compress should be repeated every 8 or 10 minutes. After the last application the part is washed off quickly with water at 75° F. and dried.

The fomentation is a means of applying heat with moisture and produces an active hyperæmia and muscular relaxation. It is of value in relieving the pain and congestion of inflammation of superficial structures.

Whirlpool bath.—The whirlpool bath is a continuous bath in a rapid current of hot water, applied to the whole or a part of an extremity. The limb is placed in a vessel of suitable size and shape in which a strong current is maintained by a continuous flow of water. To increase the pressure and reduce the amount of water needed, an aëerator is attached to the nozzle. (Figs. 126, 127.) The temperature may vary from 105° to 120° F. In cases of



FIG. 127.—Whirlpool bath for legs.

nerve injuries it is well to increase the temperature very gradually and guard against scalds of anæsthetic areas. The duration may vary from 15 minutes to 1 hour.

The whirlpool bath furnishes a means of giving heat and at the same time a very gentle massage by the current and the bubbling. An arterial hyperæmia is produced, and muscular spasm and pain are relieved.

Douche.—In the douche the patient is showered or sprayed by water. The most commonly used forms are the shower, the circular douche, and the jet and fan douche. With the shower and the circular douche (fig. 128) practically all parts of the patient's skin are exposed to fine streams of water under mild pressure. With the jet douche (fig. 129) a heavy stream of water under 20 to 35 pounds pressure is played on the patient from a distance of about 10 feet. By placing the tip of the index finger on the nozzle outlet the jet is broken up into a fan douche. (Fig. 130.) When giving a jet douche the patient stands within the stall of the circular douche. The attendant stands behind the control table and having made the adjustments for temperature and pressure directs the stream on the back, sides, and front of the trunk and extremities,

moving it up and down. The coarseness of the stream is changed to suit the patient's endurance. After a few treatments the jet usually can be borne on the back. It never is applied to the chest and abdomen.

The douche acts as a stimulant to the nerves of the skin. The impact of the water gives a mechanical excitation which brings on a rapid reaction. It is used as a finishing procedure in various forms of hydrotherapeutic measures and for stimulation in cases of physical and mental depression.

Scottish or alternate douche.—This is an application of alternating hot and cold jet and fan douches with temperatures of 100° to 125° F. for the hot and 55° to 70° F. for the cold. The hot jet is applied about five times as long as the cold, the latter being given only a few seconds each time. The duration of the whole treatment varies from one to three minutes.

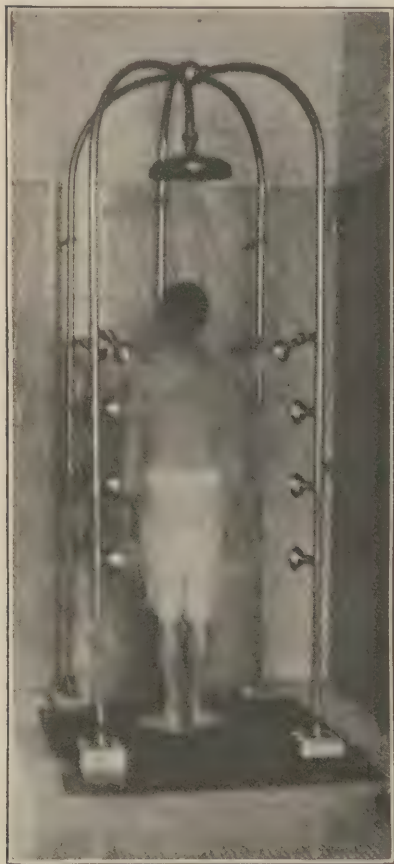


FIG. 128.—Circular douche.

RADIANT HEAT AND LIGHT.

Radiant heat and light are obtained from radiant energy, a force transmitted by the ether in the form of waves. The longer waves of this force are the Hertzian waves which are produced by spark discharges from condensers, and utilized in wireless communications. The length of these waves varies from a few meters to many thousand meters. Next to the Hertzian waves in order of decreasing wave length are the heat waves, also called infra-red rays, which extend to a wave length of less than one-thousandth of a millimeter. At this point radiant energy becomes visible as the various colors, red, orange, yellow, green, blue, indigo, and violet. White light is a combination of all the wave lengths of the visible spectrum, from the red to the violet. Beyond the violet is a region of invisible energy called ultra-violet light. Further up the scale of decreasing wave lengths we find the Roentgen rays which are about one ten millionth of a millimeter in length, and at the upper known limit the gamma rays of radium. The whole series of waves is called the spectrum of radiant energy. The parts referred to are shown diagrammatically in Figure 131. With the exception of the long Hertzian waves all these parts of the spectrum are utilized in the treatment of disease. The use of heat rays (radiant heat) and the ultra-violet rays fall within the scope of physiotherapy.

Radiant heat.—The most commonly used means of applying radiant heat for treatment purposes are: (1) The electric light bath cabinet in which the whole body, with the exception of the head, is exposed to the light and heat of a large number of electric bulbs; (2) heat applicators for the trunk, legs, and



FIG. 129.—Jet douche.



FIG. 130.—Fan douche.

arms, in which groups of from 4 to 12 carbon filament lamps, usually 130 watts, are set under a metallic reflector curved to fit these parts (fig. 132); (3) so-called deep therapy lamps in which a high wattage bulb, usually about 1,500 watts, is set in a dome-shaped reflector (fig. 133); this also is used for local treatments of various parts of the body.

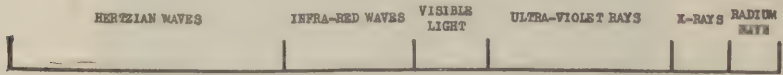


FIG. 131.—Graphic representation of the spectrum of radiant energy.

The electric light bath cabinet is used mostly in connection with hydrotherapy and mainly for two purposes: (1) To heat the skin preliminary to cold douches in order to make the cold feel less disagreeable and to favor the reaction; for this purpose the duration of the heat bath is limited to the point where visible



FIG. 132.—Heat applicator for arm.

perspiration begins to appear, usually less than five minutes; and (2) to increase the elimination from the skin, for which purpose an exposure of from 10 to 20 minutes, after the visible perspiration begins to appear, is required. The technique of giving a cabinet bath is very simple. The patient having undressed is seated in the cabinet in which the lights have been turned on for a sufficient time to have the cabinet comfortably warm. The doors are closed,

a towel is wrapped snugly around the patient's neck and a cold wet-towel turban placed on his head. If the treatment is prolonged over more than 15 minutes the patient should be watched carefully and if he complains of faintness or if the pulse becomes rapid and weak he should be taken out immediately. Faintness may be due to a current of hot air escaping in front of the patient's face through a carelessly applied neck towel. The head turban must be kept cold, either by rubbing a piece of ice over it or by renewing it about every five minutes. If it is allowed to heat up, a sensation of fullness in the head or headache may develop. During prolonged treatments the patient should drink several glasses of water. Treatments in the electric light bath cabinet must be followed always by a cold application of some kind; such as a shower bath, a circular douche, or a jet and fan douche; or if these facilities are not available an ablution or a cold plunge will be satisfactory.



FIG. 133.—Deep therapy lamp.

The heat applicators and the deep therapy lamps are used to produce an arterial hyperemia in and around inflammatory lesions of joints, muscles, lymph glands and subcutaneous tissues. It also is used in the treatment of otitis media, sinusitis, and tonsillitis. Usually these apparatus are adjusted as close to the skin as the patient will allow, the patient's sensation of heat being the best guide, except when there are areas of anesthesia, in which case the greatest care must be used to prevent burns, and when it is advisable to use a slightly greater distance than that which patients with normal sensations will allow. Radiant heat burns are very serious. They are usually deep, extending through the subcutaneous tissues and followed by extensive sloughing. The duration of a treatment should not be less than one-half hour, as a rule, the longer the exposure the better the result; but no treatment should be continuous for more than two hours. Two or three exposures daily may be given. In order to increase the hyperemia of the part treated, it may be rubbed off at intervals with ice-cold water.

Ultra-violet rays.—As the name indicates and as previously mentioned, the ultra-violet radiations are beyond the violet of the spectrum of radiant energy.

These radiations are not converted into heat when absorbed, as is the case with the infra-red, but are chemically active. For this reason they frequently are referred to as chemical rays. A familiar chemical effect of these rays is their action on the photographic film, the silver salts in the film being so changed that metallic silver is precipitated when the developer is applied. Chemically active radiations are not confined to the ultra-violet region of the spectrum but are also present in the visible spectrum, especially in the violet end. In the region of the red rays there is very little chemical effect. This explains the use of red light in the developing rooms.

Sources of ultra-violet rays.—The natural source of this energy is the sunlight, in which it is found in amounts varying with atmospheric conditions and the altitude. In cloudy or foggy weather a good part of these rays, particularly the shorter waves, are absorbed by the moisture. Smoky and dusty air similarly stops these radiations. The greatest intensity of ultra-violet rays from the sun is found in high altitudes with clear atmosphere. Artificially, ultra-violet rays are produced for therapeutic purposes in specially constructed arc lamps. The type most commonly used in this country at the present time is the mercury vapor arc lamp. Carbon arc and tungsten arc lamps are used in a few clinics. In the mercury vapor arc lamp the electric arc is sprung between two pools of mercury or one pool of mercury and a tungsten filament, all contained in a tube of quartz. To obtain a circuit the tube is tilted so that a small stream of mercury connects the two poles. The current heats up the mercury and converts some of it into a vapor which forms the arc and emits an abundance of ultra-violet radiation. The tube is made of quartz because this substance transmits all except the very shortest waves of the ultra-violet rays. Glass transmits only the longest waves just beyond the violet end of the visible spectrum.

There are two types of lamps, the air-cooled and the water-cooled. In the air-cooled lamp the burner is placed in a cylindrical or a spherical housing with adjusting devices for varying the angle of reflection of the rays and the size of the beam of light. The only means of cooling is by the air current which rises through the heated lamps.

As considerable heat is generated, 8 inches is the shortest distance at which an exposure of the skin can be made. Closer approximation will result in a heat burn.

In the water-cooled lamp the burner is enclosed in a small water-tight casing and surrounded by a metal water jacket with openings for inflow and outflow of water and with a quartz window for the transmission of the light. When this lamp is burning a continuous circulation of cold water must be maintained. This absorbs the heat radiations so effectively that the quartz window is kept cool and the lamp can be placed in contact with the skin without giving even a sensation of heat.

Effect on the skin.—The most apparent effect of ultra-violet rays on the human body is the sunburn. This is an inflammatory reaction of the skin varying from a slight redness lasting only a few hours to a severe superficial inflammation with blister formations, and followed by a brownish pigmentation. The blister is the most severe lesion that the ultra-violet rays can produce. Deep burns, such as may result from the excessive application of heat, never result from the application of ultra-violet rays. This is due to the slight penetration of these rays, the longest of which reach the depth of only 0.1 millimeter.

Ultra-violet radiations are used in the treatment of some skin diseases. Those most commonly treated by this remedy are tuberculosis of the skin, acne,

psoriasis, and eczema. Cures or improvement are due to the destruction and peeling of the diseased skin, in the same manner as the superficial layers of the healthy skin are destroyed in a sunburn, and to a stimulation of the growth of healthy skin.

Ultra-violet rays have a beneficial action not only on tuberculosis of the skin but also on tuberculosis of joints, bones, and lymph glands. For this purpose the sunlight has been found to be superior to the radiations from the mercury vapor arc.

Their effect on wounds is similar to the effect on skin diseases. The diseased tissue is destroyed and the growth of healthy granulations stimulated.

Ultra-violet radiations are believed to aid in the prevention and cure of rickets. This effect can be obtained only by radiations with wave lengths shorter than those transmitted by ordinary window glass. If sunlight is used, outdoor exposures are therefore necessary.

How to operate the mercury vapor arc and quartz lamps.—(1) The air-cooled lamp. Turn on the current and tilt the burner so as to make a stream of mercury run along the tube and close the circuit. Do not hold the burner in this position for more than a moment, otherwise the short circuit established by the metallic mercury will blow the fuse. Sometimes the tilting has to be repeated a few times before the arc is sprung. Allow the lamp to burn at least five minutes before using it. During this time the mercury forming the arc becomes completely volatilized and the intensity of the radiations reach the maximum and a constant level. Give the exposure as ordered. The order for an ultra-violet ray exposure usually specifies the distance and the time. Measure the distance from the burner to the highest point of the area to be treated. The safest way of timing the exposure is by the use of an interval timer, a clocklike device which may be set to give an alarm after any desired period from 15 seconds to two hours. In all exposures about or near the face, the eyes of the patient must be shielded by goggles. Failure to protect the eyes may cause a severe conjunctivitis often resulting seriously.

(2) The water-cooled lamp. The first step in the operation of the water-cooled lamp is to start the water circulating in the cooling device. The inflow tube is attached to a cold-water hydrant and the end of the outflow tube placed in the sink. The water is turned on to moderate pressure and when it is found to flow freely, the electric current is turned on and the lamp started in the same manner as the air-cooled lamp. Treatments by the water-cooled lamp are given commonly with the quartz window of the lamp in contact with the skin. Sometimes quartz applicators in the shape of disks or rods are attached immediately in front of the quartz window, and, by means of these, the radiations can be localized to small areas or applied in cavities such as the mouth or nose. When deep penetration of the rays is desired the blood, which is a powerful absorbent of ultra-violet radiations, is pressed out of the tissues immediately under the applicators, by slight pressure.

In order to get the maximum amount of radiations from the lamps it is necessary that the quartz burner, quartz window, and applicators are clean, and that the water in the water-cooled lamp is clear and free from particles in suspension. A thin film of dust or grease on the burner or on an applicator or cloudy water will absorb a large part of the rays. Avoid handling of the burner. Should this be necessary, it must be cleaned before being used, otherwise the marks of the fingers may be etched into the quartz and obstruct or refract the rays.

Standardizing the lamps.—Even if all orders for treatment by ultra-violet rays specify the time of exposure, the distance and other details, in order to

be reliable the operator must know certain standards in the effect of his lamps on the skin. For this purpose the reaction of the skin may be divided into four degrees.

First degree, redness but no peeling.

Second degree, redness followed by slight peeling.

Third degree, intense redness followed by peeling in strips and sheets.

Fourth degree, blistering.

To standardize a lamp it is necessary to expose the skin experimentally to determine the length of the exposure, at various distances, which will produce these four degrees of reaction. Since lamps of the same type and make vary in strength of radiations it is necessary to standardize each lamp, and further, due to the fact that a fair skin reacts to shorter exposure than a more pigmented skin, it is necessary to have two standards, one for blond people and one for brunettes. By making the experimental exposures through a small square window in a piece of material, as adhesive plaster, that does not transmit the ultra-violet rays, a large number of exposures can be made on a small area. The inner surface of the forearm is convenient for this purpose. An accurate record of the time and distance of the exposure of each square is kept and when the reaction appears and runs its course, the result in each square is checked up. In this manner the desired standard of dosage readily can be obtained.

ELECTROTHERAPY.

The constant galvanic current.

Source and apparatus.—The galvanic current used in therapeutics is a low-tension current with a voltage from 1 to 80 volts. The amperage varies from 1 to 100 milliamperes. It is obtained either from cells in series, dry or wet, or from an electric current main. The latter source is the more convenient and the most commonly used. If the current in the main is an alternating current, a motor generator or a rectifier is needed to convert the alternating to a direct current. A direct current being available, the only apparatus needed is a so-called galvanic plate, the essential parts of which are a rheostat, a milliamperemeter, and two binding posts. By means of the rheostat the strength of the current can be controlled. The amperage going through is shown by the milliamperemeter. A pair of connecting cords and a pair of electric pads complete the equipment. A graphic representation of this current is shown in Figure 134.

Technique of administration.—Soak the pads in salt solution, about 1 per cent, until thoroughly wet and squeeze them out just enough to stop the dripping. Spread a thin layer of cotton on the pad, moisten this and then apply the pads to the part to be treated. Ascertain that the current to the galvanic plate is turned off and that the rheostat control is so set that no current can go through; now join the binding posts to the pads by means of the connecting cords, turn on the current and gradually increase it by adjustment of the rheostat until the desired amount of current goes through. When the treatment is completed proceed in the reverse order, first turn the rheostat control to the neutral point, then turn off the current, and lastly remove the pads. The cotton film, having been used for sanitary reasons only, is discarded.

The constant galvanic current flows in one direction only and has a distinct polarity. At the positive pole where the reaction is acid, the vessels are constricted and the tissues hardened. At the negative pole the reaction is alkaline and the blood vessels are dilated and the tissues softened. These polar effects take place only at the pads. Between the pads, in the so-called interpolar path,

the principal effect is a mild heat which induces an increased blood supply and better nutrition of the tissues.

The effect of the negative pole is used to soften hard and adherent scars. A small pad connected to the negative pole is placed on the scar and a larger pad for the positive pole is placed on some indifferent part of the skin; for example, under the shoulders, on the abdomen, buttocks, or thighs. The inter-polar action is used in conditions such as atrophy, chronic arthritis, and neuritis where a mild heat with better blood supply helps to restore normal conditions.

How to identify the poles.—Place the metal tips of two cords connected to the binding posts in a bowl containing salt solution and turn on the current. The tip at which the bubbles form connects to the negative pole.

Interrupted galvanic current.

A galvanic current, applied with a gradual increase from zero and maintained without any sudden variations, excites no muscular contraction, but if the current is applied suddenly or interrupted, a muscular contraction results. The principal use of this interrupted galvanic current (fig. 134) is to exercise paralyzed muscles that do not respond to any other current. The current is obtained in the same manner as the constant galvanic current. The simplest and best method of interrupting it is by means of an interrupter electrode. This device is provided with a "make" and "break" key. By pressing down the handle of this key the circuit is opened (break) and when the pressure is released a spring pulls the key back which closes the circuit (make).

The sinusoidal current.

This current has a gradual and rhythmic rise and fall of voltage with a change of polarity at each rise. It differs from the simple alternating current, used for lighting and power only in that its rise from zero to maximum and its fall from maximum to zero are gradual, not sudden. A graphic representation of this current is shown in Figure 134.

The main use of this current is the exercise of paralyzed or weak muscles. In addition to the stimulation of muscular contractions, the frequent changes in polarity have a decided stimulating effect on the nutrition of the tissues. The sinusoidal current is less painful than the interrupted galvanic.

The faradic current.

This current is obtained from an induction coil. It is an interrupted and alternating current. In the ordinary faradic coil the voltage is high and interruptions rapid; in the so-called Bristow coil, which now is used extensively, the voltage is lower, the interruptions slower, and the current less painful.

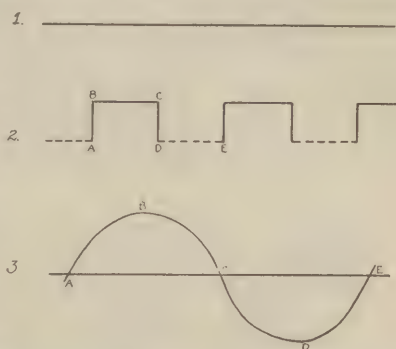


FIG. 134.—Graphic illustration of the constant galvanic, the interrupted galvanic, and the sinusoidal currents. 1. Constant galvanic. 2. Interrupted galvanic: AB represents the sudden rise at make, BC the period of flow, CD the sudden fall at break, and DE the period of no current. 3. Sinusoidal current, one complete cycle: ABC represents the rise and fall of the current flowing in one direction and CDE the rise and fall of the current flowing in the opposite direction.

The faradic current is a powerful stimulant to muscles, causing contractions that are sustained as long as the current is applied. It is used principally in the reeducation of paralyzed and weakened muscles. It is applied in a similar manner as the interrupted galvanic.

The high frequency current.

This current is an alternating current with such high frequency that it goes through the living tissue without producing any muscular contractions. Most of the high frequency machines give a current of not less than 50,000 alternations per second.

How the high frequency current is produced (fig. 135).—The main parts of a high frequency apparatus are a transformer to raise the voltage, and an oscillating circuit to produce the rapid alternations.

The apparatus operates on an alternating current. If a direct current only is available, a converter is necessary. The alternating current first is led through a rheostat through which the amount of current supplied to the apparatus can be regulated; from the rheostat the current goes into a step-up transformer, where the necessary raise in voltage is obtained. The high-tension current from the secondary windings of the transformer then is led into the oscillating circuit, which consists of a condenser, a solenoid, and a spark gap. The condensers may be considered instantaneous storage batteries capable of storing and discharging a current many thousand times a second. The spark gap is a resistance, the air between the points being the resisting substance.

The solenoid is a coil of wire with low resistance placed in conduction with the condensers.

The current from the transformer meeting the resistance of the spark gap takes the path of least resistance and goes into the condensers, placing a positive



FIG. 135.—Graphic representation of a high-frequency current.

charge on one side and an induced negative charge on the opposite side, or just the reverse, according to the phase of the alternating-current cycle. When the potential of these two charges is sufficient to overcome the resistance of the spark gap, the current sparks across, goes through the solenoid, and neutralizes the charges in the condenser. At the moment of neutralization the current in the solenoid ceases, the lines of force collapse, and a current going in the opposite direction to the first is induced in the solenoid charging the opposite side of the condenser until the spark gap breaks again. Each time the current breaks the resistance of the gap, voltage is lost and in that manner decreased until the current no longer can jump the gap. Before this standstill occurs the current has flowed back and forth hundreds of times. All these oscillations take place during one phase of the alternating current, which, in a 60-cycle current, is one one-hundred-and-twentieth of a second. As a matter of fact, the oscillations stop before the next alternation comes and there is a period of no oscillations for each alternation of the main current. Graphically, the high-frequency current may therefore be represented as in figure 136. By tapping the solenoid, the so-called D'Arsonval current is obtained. Most high-frequency apparatus also give the Tesla or Oudin current, in which the voltage is raised a second time with a corresponding decrease of amperage. The difference, then, between a Tesla or Oudin current and a D'Arsonval current is one of voltage and amperage, the D'Arsonval current being a high-frequency current of relatively low voltage and high amperage and the Oudin current a high-frequency current of high voltage and low amperage.

Methods of application.—(1) Diathermy is the application of a high frequency current to a part of the body by means of two electrodes connected to the D'Arsonval circuit. The effect of this current is a heating of the tissues traversed by the current. By varying the density of the current all degrees of heating may be produced even up to a point where the tissues are cooked and charred. When this destructive effect is desired, for example, in the removal of malignant growths, the procedure is called *electrocoagulation*.

Technique of giving diathermy.—Metal electrodes of block tin, 22 gauge, are most satisfactory. They are cut in size and shape to fit the part to be treated. In order to get the best contact possible the skin and the electrode surfaces are soaped freely. The electrodes are secured by a few turns of an elastic bandage, with just enough tension to hold the metal in contact with the skin, and then connected to a D'Arsonval circuit. With the spark gap closed, the current is turned on. By adjusting the rheostat and the spark gap, the current is increased very slowly until the milliamperemeter shows the desired amount of current. The patient should feel a sensation of heat but no burning or sticking. It is not necessary or safe to give as much as the patient can stand; mild heat frequently being more beneficial than intense heat. The treatment usually is continued for about one-half hour. When completed, the current is reduced gradually by closing the spark gap and the rheostat, and finally the main switch is turned off.

(2) *Auto-condensation.*—This may be considered as diathermy applied to the whole body. The patient is placed in an auto-condensation chair (fig. 137) which contains a metal plate fixed under an insulating material. The metal plate is connected to one terminal of the D'Arsonval circuit while a metal handle or a metal tube held by the patient is connected to the other. The patient and the metal plate are charged and discharged alternately with each oscillation of the solenoid current, the whole body being brought under the influence of the current.

(3) *Vacuum and nonvacuum electrode treatments.*—The vacuum electrodes are closed glass tubes partially exhausted to make them as good conductors as possible. A platinum wire is fused into one end, and connected to the Oudin terminal. When the current is turned on the air within the glass glows with a violet light. When the electrode is placed on the skin, showers of sparks pass from the surface of the glass, a pricking sensation is felt, and the skin becomes hot and red.

The nonvacuum electrodes are lined with a film of mercury which forms the conducting medium instead of the rarified air in the vacuum electrodes.

Static electricity.

This type of electricity is obtained from the static machine. It is a high voltage current with very low amperage. It is applied as (1) static wave current; (2) static sparks; (3) static induced current; and (4) static brush discharge. The three first mentioned forms produce very strong and deep contractions and are used to dispel congestion. The brush discharge is more superficial in its effect and is used as a counterirritant in cases of neuritis and pain from other causes.

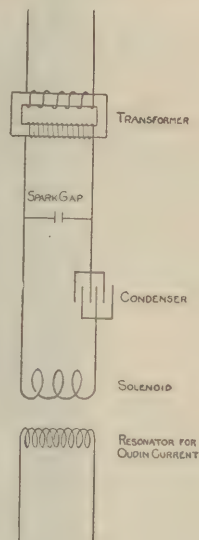


FIG. 136.—Diagrammatic representation of the circuits in a high-frequency apparatus.

Summary of effect and uses of electricity.

The electric current is used in the treatment of diseases and injuries, primarily for two purposes:

(1) To stimulate contractions of muscles. The interrupted galvanic, the sinusoidal, the faradic, the static wave, the static sparks, and the static induced current are used for this purpose.

(2) To heat the tissues and thereby induce better circulation and nutrition. The constant galvanic and the high frequency currents in the form of dia-



FIG. 137.—Auto-condensation chair.

thermy, auto-condensation, and vacuum and nonvacuum electrode currents are used for this purpose.

REFERENCES.

Massage and Therapeutic Exercises.—McMillan.

Epitome of Hydrotherapy.—Baruch.

The Principles of Electrotherapy and Their Practical Application.—Turrell.

Food and Dietetics.¹

Food may be defined as material taken into the body to supply nourishment or replace tissue waste. Every physical act on the part of an individual uses up a part of the force that has been derived from food. The maintenance of

¹ Prepared by Lieut. Commander W. A. Bloedorn, Medical Corps, United States Navy.

body heat also consumes a part of this material, and in young and growing individuals a certain amount is consumed in building up the new tissue.

Food as it is taken into the body differs greatly in composition from the material that can be utilized in cell growth and in replacing the tissue waste. The function of digestion is to alter the food in such a manner that it may be absorbed by the blood, assimilated, and utilized by the various body tissues.

CLASSIFICATION OF FOODS.

Foods may be divided into the inorganic, which include water and the various mineral salts, and the organic, which include carbohydrates, fats, proteins, and vitamins.

Inorganic foods.

Water.—Water enters into the composition of every tissue of the body and forms more than 60 per cent of the entire body weight. It acts as a solvent and aids in the elimination of waste.

Salts.—The principal salts of the body are calcium phosphate and various compounds of potassium, sodium, magnesium, and iron. The mineral salts are very necessary to life and health. The chlorides, phosphates, sulphates, and carbonates occur in combination with sodium and potassium. The phosphates and carbonates combine with calcium and magnesium. The functions of the salts are to maintain alkaline or neutral reaction of body fluids; to furnish material for acidity or alkalinity of digestive fluids; to maintain osmotic pressure; to supply the bones, teeth, and cartilage; to assist in the clotting of blood; to influence elasticity and irritability of nerves and muscles.

Organic foods.

Proteins.—These are substances which contain nitrogen, are essential to life, and are considered as combinations of the various amino-acids. They contain, in addition to carbon, hydrogen, oxygen, and nitrogen, usually some other element such as sulphur, phosphorus, iron, copper, iodine, manganese, or zinc. They differ from carbohydrates and fats in containing nitrogen. Various combinations of the above-named elements result in many different kinds of proteins. Proteins are essential to life and the body constantly is metabolizing protein whether any is being taken in as food or not. In ordinary life, the body is in protein equilibrium and such protein as is ingested is metabolized. In starvation, more protein is used up than is taken in, and in some wasting diseases, such as tuberculosis, in fevers, and in hyperthyroidism, this same condition of affairs may obtain.

In certain pathological conditions, such as nephritis, there may be retention of nitrogenous substances in the body due to failure of the kidneys to excrete them.

Protein is metabolized by oxidation processes chiefly into urea, ammonia, carbon dioxide, and water. The proteins are absorbed as amino-acids.

The source of protein foods may be either animal or vegetable. The chief animal sources are meat, fish, eggs, and milk. The chief vegetable sources are peas, beans, lentils, and peanuts. The animal foods as a rule are richer in protein than the vegetable foods.

The function of proteins is to repair tissue waste, supply material for growth, and yield energy.

Carbohydrates.—Carbohydrate is a term applied to compounds of carbon, hydrogen, and oxygen, and the name is used because most of these substances contain hydrogen and oxygen in the same proportion as it is found in water. The

carbohydrates may be divided into the monosaccharides, $C_6H_{12}O_6$, disaccharides, $C_{12}H_{22}O_{11}$, and the polysaccharides $(C_6H_{10}O_5)_x$.

Monosaccharides include lævulose, dextrose, galactose, and the glucosides. They are found in nature in fruits and as constituents of various di and polysaccharides. Dextrose or grape sugar is the result of the action of dilute acids on starch and forms the principal part of commercial glucose.

The *disaccharides* yield two molecules of monosaccharides on hydrolysis. They include cane sugar or sucrose, maltose, and lactose.

The *polysaccharides* are either insoluble or form colloids in aqueous solutions and are represented by starch, glycogen, dextrins, cellulose, various gums, mucilage, and inulin. The function of the carbohydrates is to furnish energy for muscular and nutritive processes, to help to maintain body temperature, and to form a reserve fund in the form of glycogen in time of need. The excess of carbohydrate is converted into adipose tissue.

Fats.—Fats consist of carbon, hydrogen, and oxygen, but the hydrogen content is relatively high. Fat enters into the composition of protoplasm and enables it to take up water without dissolving. The fats of the body are esters of glycerin. Glycerin is a triatomic alcohol, and all of the hydroxyl groups are replaced by acid radicals, palmitic, stearic, and oleic acids as a rule.

The source of fats is the cream and butter from milk; vegetable oils, such as olive, cottonseed, corn, coconut; meat fats, such as lard, bacon, salt pork, beef suet and drippings; fish fats or oils such as cod liver oil, and nuts such as peanuts, almonds, Brazil nuts. Fat is utilized in the body to build up the fatty tissues and enters very largely into the composition of red bone marrow. The fats are oxidized until they are reduced to carbon dioxide and water. Part of the fats of the body are derived from the transformation of carbohydrates and part also from protein. The fats form the chief fuel supply, yielding heat and energy. They are stored up as adipose tissue to form a reserve supply in time of need. They act as a protein sparer, protect the body from mechanical injury, act as a packing and support to visceral organs, especially the kidneys, and prevent too rapid loss of heat when exposed to cold.

The vitamins are discussed in the chapter on Preventive Medicine, Hygiene, and Sanitation.

The following table of Atwater illustrates the uses of the various food elements:

NUTRITIVE INGREDIENTS OF FOOD.

Food as purchased contains—	Edible portion—e. g., flesh of meat, yolk and white of egg, wheat flour, etc.	Water.	Protein. Fats. Carbohydrates. Mineral matter.
	Refuse—e. g., bones, entrails, shells, bran, etc.	Nutrients.	

USES OF NUTRIENTS IN THE BODY.

Protein forms tissues—e. g., white (albumin) of eggs, curd (casein) of milk, lean meat, gluten of wheat, etc.	All serve as fuel to yield energy in the forms of heat and muscular power.
Fats are stored as fat—e. g., fat of meat, butter, olive oil, oils of corn, wheat, etc.	
Carbohydrates are transformed into fat—e. g., sugars, starches, etc.	
Mineral matters (ash) share in forming bone, assist in digestion—e. g., phosphates of lime, etc., potash, soda, etc.	

The energy value of food.

The food that is used in the body furnishes the same amount of energy that it would furnish if burned in a furnace or calorimeter, providing the end products in each case are the same. The heat values of foods may, therefore, be taken as a standard of their food value.

The heat value of various foods may be determined experimentally by the use of an instrument known as the bomb calorimeter, the result being expressed in calories.

A calorie is the amount of heat that is necessary to raise the temperature of 1 kilogram of water 1° C.

The fuel value of the various classes of food as ordinarily supplied is as follows:

- 1 gram of protein furnishes 4 calories.
- 1 gram of fat furnishes 9 calories.
- 1 gram of carbohydrate furnishes 4 calories.

The food requirements of an individual vary with the activity, age, size, and sex. It may be said roughly that about 40 calories are required for each kilogram of body weight for an active individual.

The amount of tension under which work is done also will influence the food requirement. Even if no muscular work is done a certain amount of food is required to maintain the body. Perhaps the greatest demand is to maintain muscle tone, which probably uses up from one-third to one-half of the energy required at rest.

The following figures are those of Rubner for an adult weighing 65 kilos, or about 145 pounds:

During rest in bed	1,800 calories, or 28 calories per kilo.
In repose	2,100 calories, or 32 calories per kilo.
In light work	2,300 calories, or 33 calories per kilo.
In moderate work	2,600 calories, or 40 calories per kilo.
In hard work	3,100 calories, or 48 calories per kilo.

The occupation or the character of the work performed has a great influence on the amount and character of the food needed, and it is not well to lay down a general rule regarding caloric intake which should apply to all individuals.

In cold climates fat and protein food are used to a greater extent than in hot climates, where more carbohydrates are preferred.

As a rule women require less food than men. This is due largely to their more sedentary life and relatively small weight.

It has been shown that the amount of food needed is directly proportional to the superficial area of the body and that the metabolism varies in direct proportion to the amount of skin surface.

After determining the total amount of food required the next question to determine is how much protein, fat, and carbohydrate should be used to supply the desired number of calories. There is some difference of opinion on this subject, although we know, to a fair degree of accuracy, the amount of each which can be utilized to the best advantage. The total amount of food required depends largely upon the amount of exercise taken. The protein metabolism, however, does not depend so much upon the amount of exercise as it does upon the amount of food taken. We know that carbohydrate and fat protect the body protein, and if a diet is used which is low in protein, nitrogen equilibrium may be obtained by adding fats and carbohydrates to the diet, providing, of course, the protein intake does not fall below the minimum requirement. Ordinarily the protein intake, to supply the average body requirements, need not exceed 120 grams nor be under 60 grams daily, and it is probably safe to say that the optimum lies between these two figures, varying with the individual conditions.

As regards the amount of fat and carbohydrate in the average diet, there is also some difference of opinion, although the figures do not vary as much as

for the protein. The following distribution might be considered a fair average percentage of the various foodstuffs:

Carbohydrates	275 grams	$\times 4 = 1,100$ calories.
Fat	100 grams	$\times 9 = 900$ calories.
Protein	75 grams	$\times 4 = 300$ calories.
Total		2,300 calories.

Undernutrition lessens the natural power of resistance to diseases, while overeating puts unnecessary strain on the organs of digestion and elimination, favors obesity, and increases the amount of waste products.

Flavors and condiments.—These substances have no nutritive value, but are used to increase the appetite by rendering food more palatable and adding savor to the diet. Spices are represented by such substances as ginger, cinnamon, nutmeg, and cloves; flavoring extracts by vanilla, lemon, strawberry, and condiments by mustard, horseradish, pepper, salt, vinegar.

Beverages.—Tea and coffee may be regarded as stimulants due to the effect of caffeine, while cocoa contains carbohydrates, fats, and proteins. The various meat extracts contain little in the way of food value, but have a stimulating effect on the digestive secretions.

PLANNING OF DIET.

Probably the best way to work out a diet in an individual case is first to determine the number of calories required. Of this amount, from 10 to 15 per cent should be furnished by protein. The nature of the protein should be considered, and those containing the necessary amounts of amino-acids should be included. The proteins found in milk and meat are, as a rule, more valuable than those in vegetables. The remainder of the calories is to be made up from fats and carbohydrates. These are interchangeable within certain limits. Ordinarily the amount of fat taken does not exceed 60 to 100 grams per day and the balance is made up in carbohydrates.

The diet also should contain the various salts needed in metabolism and on a general mixed diet this will be present practically always, but on restricted diets the salts may be too low. Iron-containing foods of value are spinach, lettuce, asparagus, the legumes, yolk of egg, and meat.

Calcium is contained in such foods as milk, cheese, cauliflower, string beans, carrots, lettuce, rhubarb, oranges, and lemons.

Phosphorus is found in such foods as milk, cheese, legumes, meat, yolk of egg, oatmeal, cauliflower, spinach, lettuce, asparagus, and tomatoes. With ordinary diets these requirements easily are met and this emphasizes the importance of milk products, salads, and other green vegetables.

Foods ordinarily should furnish more bases than acids, and meats, cereals, and other acid-forming foods should be offset by those containing alkalies, as potatoes, bananas, vegetables, and fruits.

Vitamines are important and seem to bear a relation to the phosphorus content of the food. (See chapter on "Preventive Medicine, Hygiene, and Sanitation.")

There always should be an antiscorbutic in the diet such as some fresh fruit or vegetable. The food also should contain sufficient bulk.

As a knowledge of the composition, use, and digestibility of foods is essential in the planning of diets, the following principal food substances are discussed briefly:

Animal foods.

Meat.—Meat is one of the most important articles of food and is man's chief source of protein. Meat contains muscle tissue, connective tissue, blood vessels, nerves, and lymphatics, together with a varying amount of fat.

Cooking has the effect of rendering connective tissue soluble and allowing the digestive secretion to mingle more freely with the muscle fibers. It also increases the flavor and appearance of the meat and destroys bacteria which may be present in the meat.

Beef.—An ox from 3 to 5 years old supplies the best beef. The meat of a very lean animal will contain about 75 per cent of water and 2 per cent of fat. The muscles least exercised are the most tender and make the best roasts and steaks. Beef juice is nutritious when properly prepared and contains from 5 to 10 per cent of protein.

Veal.—Veal is more difficult to digest than beef and is obtained from calves 6 to 10 weeks old. In some persons it tends to produce digestive disturbances and is to be avoided in cases of digestive disability.

Mutton.—Mutton is obtained from the 3 to 5 year old sheep and is considered by some writers more digestible than beef.

Lamb.—Is obtained from sheep less than a year old and is as digestible as beef or mutton but contains relatively too much fat.

Pork.—Pork is the most indigestible of all meats on account of the large percentage of fat it contains.

Ham and bacon.—Ham and bacon are both more digestible than pork. When cooked crisp, thin slices of bacon are digested easily.

Animal viscera.—Animal viscera are not quite so nutritious as most meats. Tripe, liver, kidney, and brains are used extensively. The heart is tough and indigestible. Sweetbreads, either the pancreas or the thymus gland of the calf, are digested easily.

Poultry.—Chicken is one of the most digestible and agreeable varieties of meat. Squab is also a desirable and easily digested food. Game birds are digested easily and are richer in extractives.

Fish.—Fish is used very widely as a food and is always best used in season. Fish are in best condition just before spawning. After this process they become thin and unfit for food. Fish undergo decomposition rapidly and as a rule should be eaten in as fresh condition as possible. Shell fish (oysters, clams, and mussels) may be eaten raw or cooked. Oysters, when eaten raw and fresh, are very digestible but when cooked are less easily digested.

Eggs.—Hens' eggs are consumed in large quantities but those of the duck, turkey, guinea hen, and wild fowl also are eaten. Eggs contain mainly protein and fat in addition to water and mineral matter. Eggs are highly nutritious and when served with milk or broth form an important article of diet for convalescent patients.

Milk.—Milk is probably the most important of animal foods, containing all the elements necessary for the maintenance of life. It forms the exclusive diet for young growing mammals but is unsuited as an exclusive diet for adults. It contains about 4 per cent of fat, 3.3 per cent of protein, 5 per cent of carbohydrate, 0.7 per cent of mineral matter, and 87 per cent of water. Heat is employed in keeping milk, usually by two methods—either sterilization or Pasteurization. *Sterilization* is accomplished by boiling for 10 minutes or longer. There are certain objections to sterilized milk as it kills the ferments and places milk in the class of so-called "dead foods." It may be used to advantage, however, in very hot weather when ice is not available. *Pasteurization* means heating the milk to about 167° F. and maintaining this degree of temperature

from 20 to 45 minutes, and then cooling the milk rapidly to about 40° F. This treatment kills most of the bacteria, particularly the pathogenic bacteria, but does not render the milk sterile; however, it does not materially change the composition of the milk. Pasteurized milk must be kept cool to prevent deterioration.

Vegetable foods.

Vegetable foods differ from animal foods in that they contain more starch and sugar and a relatively small amount of protein.

Cereals.—These are the most important of the vegetable foods and to this class belong wheat, corn, rye, oats, barley, rice, and buckwheat. The cereals are supplied chiefly in the form of flour or meal.

Legumes.—Peas and beans are the most important legumes and contain a liberal proportion of protein. Lentils are used comparatively little in the United States, but are used extensively in other countries. Peanuts belong to this class and differ from other legumes in that they contain a large amount of fat. The principal legumes, peas and beans, should be well cooked so that the cellulose enclosing the vegetable cells is broken down.

Roots and tubers.—This includes potatoes, sweet potatoes, yams, artichokes, beets, carrots, parsnips, turnips, and radishes. They contain both starch and sugar but are relatively lower in nutritive value than either legumes or cereals.

Green vegetables.—Green vegetables are valuable not only on account of their nutriment but for variety and relish and for their content of salts and vitamins. They also give bulk to the food which is important on account of its mechanical action in maintaining a healthy alimentary tract. The principal articles of food in this class are cabbage, cauliflower, spinach, lettuce, sorrel, tomatoes, eggplant, cucumbers, asparagus, rhubarb, pumpkin, squash, onions, and garlic.

Fruits and nuts.—*Fruits* are used extensively as flavoring agents. Their chief nutrient constituent is sugar, the principal sugar being levulose and sometimes cane sugar. The mineral elements of fruit contain potash with tartaric, stearic, and malic acids. The antiscorbutic properties of fruits are due to their salts and vitamins. Fruits also act as diuretics and laxatives. The most easily digested fruits are oranges, lemons, grapes, and peaches. Apples, pears, and bananas are slightly less digestible.

Nuts contain a large quantity of fat and somewhat more protein than fruits. They are taken mainly as a dessert and as a rule do not constitute a large source of nutriment. They are not digested easily as a rule, owing to the large amount of cellulose and high proportion of fat.

SPECIAL METHODS OF FEEDING.

Special methods of feeding include rectal feeding, duodenal alimentation, nutrient inunctions, intravascular injection, saline irrigations and saline infusions.

Nutrient enemata.—This consists in the administration of food by rectum. With careful technique, a patient may be fed by rectum for a period of several weeks, although it is doubtful if more than one-sixth to one-fourth of the total caloric requirements can be supplied in this manner. The rectum first should be cleansed thoroughly by high injection of normal saline solution an hour before the enema is to be given. This cleansing enema should be given at least once a day.

Nutrient enemata may be indicated in extremely weakened conditions when the quantity of food taken through the mouth is insufficient to maintain life; in obstruction of the pharynx or œsophagus, and in paralytic conditions of

the pharynx when the patient is unable to swallow food; in diseases of the stomach, as in cancer with stricture and in delirious, comatose, or insane persons who can not be fed by mouth.

The usual nutrient enema consists of milk, which has been pancreatized for 24 hours and boiled, about 8 ounces, to which may be added either 2 to 3 drams of dextrose, 2 to 3 drams of alcohol, one or two yolks of egg, or a combination of all three.

The nutrient enema usually is given by the drop method and it is sometimes advisable to add 10 or 15 drops of tincture of opium as a sedative.

Duodenal alimentation.—This consists of feeding through a duodenal tube which has been introduced through the stomach and is a desirable way of feeding a patient in conditions in which the stomach needs a rest.

Nutrient inunctions.—Particularly if oils such as olive oil, cod liver oil, coconut oil, or cocoa butter are used, nutrient inunctions are sometimes of value, especially in infants suffering from marasmus or malnutrition.

Intravascular injection.—This consists in introducing fluid into a vein, usually in the form of salt, alkaline, and glucose solutions. It usually is practiced as an emergency measure and not as a routine procedure.

Subcutaneous feeding.—This method of administration is somewhat unsatisfactory, but solutions of glucose in normal salt solution and also olive oil have been given in this manner.

Saline irrigation and infusion.—Saline irrigations by rectum are especially useful in such conditions as hemorrhage and in various acute fevers when it is inadvisable to give fluids by mouth. They serve to allay thirst and are a very useful means of increasing the amount of fluid in the system. Saline infusion given subcutaneously is useful in cases where the patient can not retain a rectal solution and usually is given in the chest wall, lumbar region, abdominal wall, or buttock.

DIET IN DISEASES.

In feeding the sick, it is advisable to carry out the patient's wishes whenever practicable, and to a certain extent make allowance for likes and dislikes and certain idiosyncrasies. A tactful, observing, and sympathetic nurse who acquaints himself or herself with these facts will be of the greatest help to the physician in carrying on his dietary régime. The nurse should have a knowledge of practical dietetics and of the amount of food required by different types of patients.

Food should be given at regular intervals. This is particularly important in semiconscious or comatose patients, and in the conscious patient regularity in meals is also of distinct advantage.

The appetite of the convalescent patient requires catering to, as patients in this condition are apt to be more fastidious than when they are well.

The sick room should be neat, and no dishes, utensils, or food allowed to stand about the room either before or after using. Food and drink should be served from scrupulously clean utensils. These utensils should be as attractive as possible, and the food must be dainty and appetizing in appearance. If the patient approaches his food with the flow of his digestive secretions stimulated by the psychic reaction to the odors and appearance of the food, he is in a position to get the greatest amount of good from his meal.

An attractive dish, garnished with sprigs of green, accompanied by clean linen and bright silverware, will go a long way toward accomplishing this result.

Food that is stale or has acquired an unpleasant odor or taste from standing in a refrigerator should never be given. A strong egg in an eggnog or an

odorous piece of meat may be the means of turning the patient away from much needed nourishment.

The patient should be made to feel that the utmost cleanliness and care have been observed, and the face and hands of the patient should be cleansed before food is given, and the lips and teeth cleansed after the meal is completed. If the mouth is dry, it should be moistened from time to time with a mixture of water, glycerin, and lemon juice.

Anæmia.—The diet in anæmia should consist of easily digested food relatively rich in iron and other salts, such as milk, eggs, raw beef, beef juice, oat-meal, whole-meat preparations, green vegetables, and fruits.

Cardiac diseases.—In acute heart failure with œdema, the patient usually is placed on a restricted diet consisting of 800 to 900 c. c. of milk in 24 hours until the œdema tends to disappear. The transition from milk to a more solid diet is begun slowly by adding gradually soft cooked eggs, dry toast, baked potato, fish, or the white meat of chicken. Later, as the cardiac condition improves, more solid food is given, but never a large amount of food at any one meal, in order to avoid embarrassing the heart by a well-filled stomach.

Constipation.—In the ordinary type of constipation, due to sluggish action of the bowel, and not due to mechanical obstruction, it is advisable to give food which tends somewhat to irritate and stimulate peristalsis, such as oat-meal, whole wheat, vegetables, fruit, and a liberal amount of water.

Diarrhœa.—In the ordinary type of diarrhœa, due to an acute gastro-intestinal disorder, give bland nonirritating liquids for a diet, well-cooked and strained gruels, such as arrowroot, farina, and rice, and boiled milk. Later, as the condition improves, lean meat and fish, potatoes, simple extracts, and milk puddings may be added.

Diabetes.—The ordinary preliminary treatment consists in a starvation diet until the urine is free from sugar. During this period only bouillon or clear soup is given. After the urine has been free from sugar for 24 hours, proteins and carbohydrates are slowly added until tolerance is reached, together with easily digested food, such as bacon, butter, or cream. The amount of fat always should bear some relation to the amount of carbohydrate ingested, as a certain amount of carbohydrate is necessary to properly metabolize the fat ingested. Saccharine may be substituted for sugar for sweetening purposes. The diet of a diabetic as a rule easily can be made up to the required bulk by using a liberal quantity of green vegetables which contain a low amount of carbohydrate. Later, as the limit of tolerance is reached, the patient should be kept under close observation for any evidence of acidosis or glycosuria.

Gastric ulcer.—Lenhartz or Sippy diet or some similar diet is probably the most generally used. This consists of hourly feedings during the first 10 days of small amounts of milk and cream, between which feedings alkalies are given by mouth. Later the feedings are given at two-hour intervals, and at the end of four or five weeks five or six feedings a day are given, with gradual addition of semisolids and later solid foods.

Gout.—Prohibit food of glandular organs, such as sweetbreads, liver, kidneys, and all food rich in extractives, as well as acid and highly seasoned foods. The diet should consist principally of milk, cream, eggs, butter, farina, tapioca, cornstarch, extracts, ice cream, water ices, potatoes, and possibly a little boiled meat.

Nephritis.—In an acute attack with œdema, avoid condiments and salt in the diet and give bland, easily digested food with not more protein than is necessary to maintain the basal requirements, the balance of the diet being made up from carbohydrates and fats in sufficient amounts to maintain the caloric

requirements of the individual. In some cases the Karell diet is recommended, consisting of 800 c. c. of milk a day, although it is not considered advisable to maintain the patient on this diet for any length of time.

In the chronic forms of nephritis the above principle still holds, it being advisable to throw the minimum amount of work on the kidneys and to eliminate all irritating and highly seasoned dishes from the menu. The restriction of protein intake below that required for the actual body needs is inadvisable, as if insufficient protein is derived from the food the patient will make up the deficiency from his own tissues.

As regards the amount of water a patient with nephritis should take, it is not advisable to lay down any specific rule, as the amount which should be taken in each case depends upon the ability to excrete water, and this can be ascertained readily if the amount ingested and the amount excreted is measured daily.

Obesity.—In obesity, determine the number of calories you wish the patient to have each day, giving less, of course, than the amount required to maintain the weight of the patient. Ordinarily, if a patient is up and about and can combine a restricted diet with a certain amount of exercise, the efforts at reduction of weight will be much more effective. A diet containing 1,200 to 1,500 calories per day, together with exercise, such as walking 3 to 5 miles a day, usually will accomplish the desired result. If the patient is placed on foods of low caloric value such as the green vegetables, and items such as butter, cream, bread, and potatoes eliminated from the diet, he usually can get along without suffering inconvenience or severe hunger.

Fevers.—In fever the metabolic processes are increased and the power of assimilation is lowered. In order to maintain a fever patient properly the food should be easy to take, easy to digest, and readily assimilated. Milk is the almost universally used food in this condition, but must be supplemented by additional items. Cream is of great value owing to its high caloric content, and eggs also constitute a valuable addition to the diet. Meats ordinarily are not used in fevers, although the meat juices may be used occasionally. The balance of the diet may be made up from sugars and starches, and sufficient fluid should be supplied to keep the patient comfortable.

Tuberculosis.—It is advisable to take meat, milk, and eggs in as large quantities as can be digested and to give some form of raw meat daily. The patient should be impressed with the fact that diet is of primary importance in the treatment of this disease and should be given specific directions covering articles eaten as well as those to be avoided. A small diet well digested and assimilated is much better than overfeeding. The nutrition of the patient is a reliable guide as to the progress of the disease. There can be no doubt that food prepared in an appetizing manner and which is digested and assimilated easily is one of the most important factors in treating tuberculosis. A good chef is probably as valuable an adjunct to a tuberculosis sanitarium as the medical man himself.

CLASSIFICATION OF DIETS.

The ordinary diets used in the Navy may be generally divided into the following classes: Liquid, soft, regular, and special diets. *Liquid diet* may be prescribed with or without milk and consists of sweet milk, buttermilk, whey, cocoa, cream soups, eggnogs, ice cream, broths, strained gruels, beef tea, beef juice, barley or ice water, albuminous drinks, tea or coffee. *Soft diet* includes, in addition to the above articles, eggs (soft boiled, scrambled, or poached), dry and milk toast, extracts, gelatin, oranges, grapefruit, prunes, baked apples,

blancmanges, and cereals. *Regular diet* is the same diet given to the regular mess, with the exception of having fruit and cereal added to the breakfast and stewed or fresh fruits added to the evening meal.

Under the heading of special diets, we may put in the Lenhartz, Sippy, Karel, and the other special dietaries which are indicated in some particular diseases and which the medical officer may prescribe for some particular case.

RECIPES.¹

Peptonized milk (warm process).—Put one-half cup (gill) of cold water and the powder contained in one peptonizing tube into a clean quart bottle and shake thoroughly; add a pint of cold fresh milk and shake again; then place the bottle in a pail or kettle of warm water at about 115° F., or not too hot to immerse the whole hand in it without discomfort. Keep the bottle in the water bath for 5 or 10 minutes, or longer if it is desired to peptonize the milk quite completely, then put it immediately on ice in order to check the process of digestion and keep the milk from spoiling. The container should be placed directly in contact with the ice.

The degree of peptonization is regulated very simply in this process by the length of time during which the milk is kept in the water bath. It is seldom necessary to peptonize milk until it becomes bitter.

In the following formulas for preparation of food for the sick, those marked with an asterisk are quoted from "Dietetics for Nurses," by F. T. Pröudfit.

* ORANGEADE.

Juice of 1 orange.	Juice of $\frac{1}{2}$ lemon.
1 tablespoonful sugar.	Enough water to fill the glass.

* ALBUMINIZED ORANGEADE.

Make orangeade as directed in above recipe without the addition of water. Break the whites of two eggs into a saucer and with scissors cut the albumin until free from membrane and strain, stir this into the orange juice and add several pieces of cracked ice. This is both nourishing and palatable, and the taste of the egg can not be detected.

Egg Nog.

1 egg.	$\frac{3}{4}$ cup milk.
$\frac{3}{4}$ tablespoonful sugar.	Flavor with nutmeg.
Speck of salt.	

Beat the egg, add the sugar and salt; blend thoroughly, add the milk and nutmeg. Serve immediately.

* COCOA.

2 teaspoonsful cocoa.	$\frac{1}{2}$ cup boiling water.
$\frac{1}{2}$ teaspoonful sugar.	$\frac{3}{8}$ cup milk.

Mix cocoa and sugar together and add boiling water slowly. Boil 3 to 5 minutes; heat milk in double boiler and add cocoa mixture. Beat with egg beater to distribute cocoa and prevent scum forming. Serve with or without whipped cream. Cocoa may be reinforced as directed in "broths" with albumin or the whole or yolk of one egg well beaten. If the white alone

¹ Prepared by members of the faculty of the United States Naval Hospital Corps Training School, San Francisco, Calif.

is used, care must be observed that the liquid is not enough to coagulate the albumin. Proprietary foods and casein preparations are used in like manner.

* MALTED MILK CHOCOLATE OR COCOA.

1 tablespoonful malted milk.	2 ounces water.
1 tablespoonful cocoa or grated chocolate.	$\frac{1}{2}$ teaspoonful sugar.
6 ounces milk.	4-5 drops vanilla extract.

Mix cocoa or chocolate with water and boil 2-3 minutes. Pour milk into a double boiler and heat, mix malted milk with a little water and stir into the hot milk, add the cocoa paste, sugar, and vanilla, beat the mixture briskly to mix ingredients thoroughly, and serve with or without cream.

CHOCOLATE SYRUP.

1 ounce (3 tablespoonsful) chocolate.	$1\frac{1}{2}$ cups sugar.
1 cup boiling water.	1 tablespoonful of vanilla.

Put chocolate in a saucepan and add the water gradually, stirring all the time. Add sugar and stir until it begins to boil; boil three minutes, strain, cool, and add one tablespoonful vanilla. Bottle and keep in a cold place.

CHOCOLATE SHAKE. (Individual rule.)

2 tablespoonsful chopped ice.	$\frac{1}{2}$ cup milk.
2 tablespoonsful chocolate syrup.	$\frac{1}{4}$ cup soda water or carbonated water.
3 tablespoonsful whipped cream.	

Shake or stir well before drinking. A tablespoonful of vanilla ice cream is a desirable addition. It is a delicious drink, even if the soda or carbonated water are omitted.

A plainer drink is made by combining the syrup, three-fourths cup milk, and the ice, and shaking well.

* COFFEE.

2 tablespoonfuls ground coffee.	1 cup boiling water.
2 teaspoonfuls white of egg.	$\frac{1}{4}$ cup cold (boiled) water.

Mix coffee with 1 tablespoonful of cold water and egg white in small pot (after scalding pot), add boiling water; allow to boil 3 minutes; stir down and add cold water; set pot where coffee will stay hot, but not boil, for 10 to 15 minutes, serve with cream and sugar or to flavor use hot milk.

* Coddled Egg.

1 egg.	1 pint water.
--------	---------------

Allow water to boil; wash egg; drop into boiling water and place saucepan where water will keep hot, but not boil; allow to stand 7 or 8 minutes. Serve with salt.

* SOFT COOKED EGG.

Proceed as for coddled eggs, but allow egg to remain from 10 to 15 minutes or even longer, if very soft eggs are not desired.

* POACHED EGG.

Have small, shallow saucepan half filled with boiling water or milk, if an egg poucher is at hand, use that; otherwise, lower a flat perforated spoon into water and place where the water cannot boil. Break the egg carefully into

the spoon, taking care not to break the yolk; allow to stand in hot water until the white is of the consistency of jelly; lift out, slide egg on to hot toast, taking care not to break. (A broken poached egg is very unappetizing, as well as untidy in appearance).

SCRAMBLED EGG.

1 egg.	1/4 teaspoonful salt.
1/4 cup milk.	Small pinch pepper.
1 teaspoonful butter.	

Beat egg in top of double boiler until light, add milk and rest of ingredients and stir over boiling water until it thickens; allow it to stand a few minutes without stirring, to set. Serve on toast or hot rice.

* BAKED CUSTARD.

1 egg.	3/4 cup milk.
1 tablespoonful sugar.	A few drops of vanilla.

Beat eggs and sugar together, stir into milk. grease custard cup with butter, pour in the mixture. Set cup on several layers of paper in a deep pan, surround with hot water (to about half its depth). Set pan in moderate oven and allow to cook slowly until custard is firm in the center. It may be served hot or chilled and turned out, with a tablespoonful of whipped cream on top.

Care must be taken not to allow the oven to get hot, or the egg will coagulate, making a watery, unpalatable, and indigestible mixture.

* SOFT CUSTARD.

1 egg (or 2 yolks).	1 cup milk.
1 tablespoonful sugar.	A few drops of vanilla.

Heat milk in double boiler. Beat egg and sugar together. When milk has reached the scalding point (small bubbles form around the edge of the saucepan), stir in the egg. Care must be taken not to allow the water under the saucepan to become too hot, as the custard will curdle if the egg is cooked at too high a degree of temperature. The custard must be stirred constantly in the beginning until it begins to thicken, then several times a minute until it is of the desired consistency and the raw taste is cooked out of the egg. This mixture is done when it will form a coating upon the spoon. Serve with whipped cream on top.

BEEF TEA WITH HYDROCHLORIC ACID.

Select one-half pound of good beef; remove everything that is not clear meat. Chop it fine. Put in pint fruit jar and add one cup cold water and five drops dilute hydrochloric acid. Stir and set in refrigerator or any cold place for two hours to digest. Then strain, season with salt, and serve in dainty china cup on account of color. If one should object to color, heat the tea in a double boiler just till color changes. Do not strain. Beef tea made in this way is recommended by physicians for feeble children and patients much weakened by sickness.

BEEF JUICE.

Select a piece of meat from the rump or top of the round. Remove all fat and broil or warm slightly one or two minutes, to set free the juices; lay on plate and cut meat in various directions that more juice may be extracted; then squeeze out the juice by means of a press, lemon squeezer, or potato ricer

into a slightly warmed cup. Salt if necessary, and serve at once. Prepare only enough to serve, as it does not keep well. Serve in dainty china cup to disguise color. One pound of meat yields four ounces of juice.

ORANGE JELLY. (Individual rule.)

1 teaspoonful granulated gelatin.	2 tablespoonfuls sugar.
1 tablespoonful cold water.	3 tablespoonfuls orange juice.
3 tablespoonfuls boiling water.	2 teaspoonfuls lemon juice.

Soak the gelatin in the cold water one-half hour; add the boiling water and dissolve. Add sugar and fruit juice, strain through a cloth and strainer into cold, wet mold.

COCOA JUNKET. (Individual rule.)

1 tablespoonful cocoa.	½ Junket tablet.
2 teaspoonfuls sugar.	1 teaspoonful cold water.
2 tablespoonfuls boiling water.	3 drops vanilla.
1 cup milk.	

Mix the cocoa, sugar, boiling water, and cook over heat and rub to a smooth paste; add gradually the fresh cool milk. Heat until lukewarm (not more), add vanilla and then tablet dissolved in the cold water. Pour mixture immediately into sherbet cups, partly full. Stand in warm room undisturbed until firm, like jelly, then put on ice to cool.

REFERENCES.

Practical Dietetics (Diet in Health and Disease).—A. F. Pattee.
 Dietetics for Nurses.—Proudfit.
 Diet in Health and Disease.—Friedenwald and Ruhrah.

CHAPTER V.

PREVENTIVE MEDICINE, HYGIENE, AND SANITATION.¹

PRACTICAL PREVENTIVE MEDICINE.

Preventive medicine may be defined as that branch of science that deals with prevention and control of disease. Hygiene and sanitation, which are included within its scope, often are confused with it. Hygiene is the science of health, or the proper care of the body to permit the proper functioning of the various organs and tissues, whereas sanitation is the proper care of man's surroundings or environment.

Preventive medicine must not be restricted to the prevention and control of diseases, communicable from man to man or from animal to man by means of microorganisms, but should be considered as the prevention and control of all diseases with which man is afflicted. For instance, the prevention of diseases due to lack of proper food, to the lack of exercise, to faulty methods of living, to improper working conditions, and atmospheric conditions, are as much a field of preventive medicine as the prevention of communicable diseases. However, the greatest success thus far has been obtained in the prevention of infectious diseases, and particularly the so-called environmental diseases. In the practice of preventive medicine it is necessary or desirable to know the cause, the nature, and in what manner man contracts a disease before such diseases may be controlled. This study of epidemic diseases is known as *epidemiology*. Once the epidemiology of a disease is known the control becomes much easier. However, this is not always the case, for some diseases were controlled about as well before the discovery of the cause of the disease as they have been since. As an example, smallpox, for which neither the cause nor the exact means of transmission are known, is one disease which may be controlled practically completely.

The control of communicable diseases is a problem with which the medical officer and the hospital corpsman have to deal constantly. Therefore, the communicable diseases which are most liable to attack the Navy will be dealt with in detail. Before considering each communicable disease separately it will be well for the reader to have an understanding of some terms which will be used.

Source of infection.—Man is the great reservoir of infection for organisms pathogenic to man. However, some animals also harbor organisms pathogenic to man. Not only the individual ill with a disease may harbor the organisms but those who are well may act as carriers.

Modes of transmission (Fig. 138).—These may be classified in the following general groups:

- (a) Contact.
- (b) Foods, including water and ice, milk and dairy products, meat and shellfish, and vegetables.
- (c) Insects. Mechanical transmission. Biological transmission.
- (d) Soil.
- (e) Fomites.

¹ Prepared by Lieut. Commander R. F. Jones, Medical Corps, United States Navy.

Carrier.—A person who, without symptoms of a communicable disease, harbors and disseminates the specific microorganisms.

Cleaning.—This term signifies the removal, by scrubbing and washing, of organic matter on which and in which bacteria may find favorable conditions for prolonging life and virulence; also the removal by the same means of bacteria adherent to surfaces.

Contact.—A "contact" is any person or animal known to have been sufficiently near to an infected person or animal to have been exposed to the transfer of infectious material directly or by articles freshly soiled with such material.

Means of contact transmission of disease.—These may be grouped as follows:

(a) Mouth spray or droplet infection. In talking, coughing, or sneezing persons emit from the mouth a fine spray of saliva which will contain microorganisms harbored in the mouth, nasopharynx, and respiratory passages of

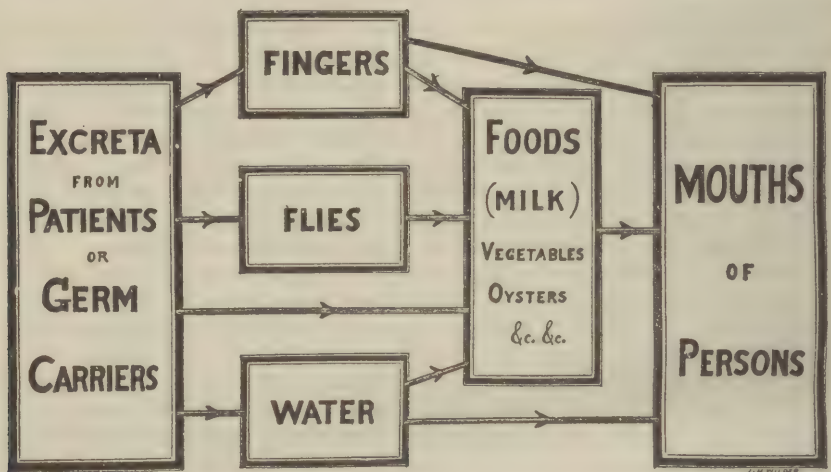


FIG. 138.—Illustrating the participation of several routes of dissemination in the propagation of the typhoid bacillus. (U. S. Public Health Reports.)

the infected individual. Droplets will remain suspended in the air for varying lengths of time and air currents may distribute them short distances. Ultimately they will dry and desiccation of the microorganism will occur. The radius of droplet infection without air current is about 6 or 8 feet.

(b) Hands and fingers contaminated with secretions are unquestionably the most important agencies in contact infection. Hands and fingers may infect directly or indirectly.

(c) Direct approximation of body surfaces of two different individuals, such as that occurring during kissing or sexual intercourse.

Delousing.—By delousing is meant the process by which a person and his personal apparel are treated, so that neither the adults nor the eggs of *Pediculus vestimenti*, *Pediculus capitis* or *Phthirus pubis* survive.

Disinfection.—By this is meant the destroying of the vitality of pathogenic microorganisms by chemical or physical means. When the word *concurrent* is used as qualifying disinfection, it indicates the application of disinfection immediately after the discharge from the body of an infected person of infec-

tious material or the soiling of articles with such infectious discharges. When the word *terminal* is used as qualifying disinfection, it indicates the process of rendering the personal clothing and immediate physical environment of the patient free from the possibility of conveying the infection to others at the time when the patient is no longer a source of infection. For methods of disinfection see page 265.

Education in personal cleanliness.—By this phrase it is intended to include all the various means available to impress upon all members of the community, young and old, and especially when communicable disease is prevalent or during epidemics, by spoken and printed word, and by illustration and suggestion, the necessity of—

(1) Washing the body daily with soap and water.

(2) Washing the hands in soap and water after voiding bowels or bladder and always before eating.

(3) Keeping the hands and unclean articles, or articles which have been used for toilet purposes by others, away from mouth, nose, eyes, ears, and genital organs.

(4) Avoiding the use of common or unclean eating, drinking, or toilet articles of any kind, such as towels, handkerchiefs, hairbrushes, drinking cups, pipes, etc.

(5) Avoiding direct exposure to the spray from the noses and mouths of people who cough and sneeze, or laugh and talk loudly, with wide-open mouth, or in explosive manner.

Fumigation.—By fumigation is meant a process by which the destruction of insects, as mosquitoes and body lice, and animals, as rats, is accomplished by the employment of gaseous agents.

Isolation.—By isolation is meant the separating of persons suffering from a communicable disease, or carriers of the infecting organism, from other persons, in such places and under such conditions as will prevent the direct or indirect conveyance of the infectious agent to susceptible persons.

*Quarantine.*²—By quarantine is meant the limitation of freedom of movement of persons or animals who have been exposed to communicable disease for a period of time equal to the incubation period of the disease to which they have been exposed.

Renovation.—By renovation is meant, in addition to cleansing, such treatment of the walls, floors, and ceilings of rooms or houses as may be necessary to place the premises in a satisfactory sanitary condition.

Report of a disease.—By "report of a disease" is meant the notification sent to the health authorities, and, in the case of communicable diseases in animals, also to the respective departments of agriculture, who have immediate jurisdiction, that a case of communicable disease exists in a specified person or animal at a given address.

Susceptibles.—A susceptible is a person or animal who is not known to have become immune to the particular communicable disease in question by natural or artificial processes.

² In view of the various ambiguous and inaccurate uses to which the words "isolation" and "quarantine" not infrequently are put, it has seemed best to adopt arbitrarily the word "isolation" as describing the limitation put upon the movements of the known sick or "carrier" individual or animal, and the word "quarantine" the limitations put upon exposed or "contact" individuals or persons.

GROUP I. DISEASES TRANSMITTED BY DISCHARGES FROM THE MOUTH AND NOSE.

- * Diphtheria.
- * Scarlet fever.
- * Measles.
- * German measles.
- * Whooping cough.
- * Mumps.
- * Pneumonia.
- * Cerebrospinal fever.

- * Influenza.
- * Tuberculosis.
- * Septic sore throat.
- Tonsillitis, acute follicular.
- Leprosy.
- Pollomyelitis, acute.
- Vincent's angina.

NOTE.—Those diseases marked with asterisk are discussed.

Cerebrospinal fever.

1. *Infective agent*: *Diplococcus intracellularis meningitidis* (the meningococcus).

2. *Source of infection*: Discharges from the nose and mouth of infected persons. Clinically recovered cases, and healthy persons who have never had the disease but have been in contact with cases of the disease or other carriers, act as carriers and are found frequently, especially during epidemics. Such healthy carriers not uncommonly are found independent of epidemic prevalence of the disease.

3. *Mode of transmission*: By direct contact with infected persons and carriers, and indirectly by contact with articles freshly soiled with the nasal and mouth discharges of such persons.

4. *Incubation period*: Two or ten days, commonly seven. Occasionally for longer periods when a person is a carrier for a time before developing the disease.

5. *Period of communicability*: During the clinical course of the disease and until the specific organism no longer is present in the nasal and mouth discharges of the patient. The same applies to healthy carriers so far as it affects persistence of infectious discharges.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by the microscopic and bacteriological examination of the spinal fluid, and by bacteriological examination of nasal and pharyngeal secretions.
2. Isolation of infected persons and carriers until the nasopharynx is free from the infecting organisms, or, at the earliest, until one week after the fever has subsided—while it is not necessary to culture the entire personnel of a station, it should be the practice of the service to culture all contacts and to isolate the positives found among them.
3. Immunization may prove of value. Immunization by the use of vaccine is still in the experimental stage.
4. Quarantine—None.
5. Concurrent disinfection of discharges from the nose and mouth and of articles soiled therewith.
6. Terminal disinfection—Cleaning.

(B) General measures—

1. Search for carriers among families and associates of recognized cases by bacteriological examination of posterior nares of all contacts. Carriers should be observed daily.

6. *Methods of control*—Continued.

(B) General measures—Continued.

2. Education as to personal cleanliness and necessity of avoiding contact and droplet infection.
3. Prevention of overcrowding, such as is common in living quarters, transportation conveyances, working places, and places of public assembly in the civilian population, and in inadequately ventilated closed quarters in barracks, camps, and ships among military units.

Diphtheria.

1. *Infectious agent*: *Bacillus diphtheriae* (the Klebs-Loeffler bacillus).

2. *Source of infection*: Discharge from diphtheritic lesions of nose, throat, conjunctiva, vagina, and wound surfaces. Secretions from the nose and throat of carriers of the bacillus.

3. *Mode of transmission*: Directly by personal contact, indirectly by articles freshly soiled with discharges usually from nose and throat or through infected milk or milk products.

4. *Incubation period*: Usually two to five days, occasionally longer if a healthy carrier stage precedes the development of clinical symptoms.

5. *Period of communicability*: Until virulent bacilli have disappeared from the secretions and the lesions. The persistence of the bacilli after the lesions have healed is variable. In fully three-quarters of the cases they disappear within two weeks. In 65 per cent of cases the bacilli disappear in four weeks. In exceptional cases virulent bacilli remain in the throat and discharges for from two to six months.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—By clinical symptoms with confirmation by bacteriological examination of discharges.
2. Isolation—Until two cultures from the throat and two from the nose, taken not less than 24 hours apart, fail to show the presence of diphtheria bacilli. Isolation may be terminated if persistent diphtheria bacilli prove avirulent. Where termination by culture is impracticable cases may be terminated with fair safety as a rule 16 days after onset of the disease.
3. Immunization—Exposed susceptibles to be promptly immunized by antitoxin. (By susceptibles is meant such individuals as are found to be nonimmune by the Schick test, i. e., those who give a positive reaction.) This procedure is costly and its effectiveness difficult to determine.
4. Quarantine—All exposed persons until shown by bacteriological examination not to be carriers.
5. Concurrent disinfection of all articles which have been in contact with the patient and all articles soiled by discharges from the patient.
6. Terminal disinfection—At the end of the illness, thorough airing and sunning of the sick room, with cleaning or renovation.

(B) General measures—

1. Pasteurization of milk supply.
2. Application of the Schick test to all contacts, and immunization of all susceptibles. The application of the Schick test to all men in the Navy who have been exposed is not always practicable and this process is left to the discretion of the individual medical officer.

6. *Methods of control*—Continued.

(B) General measures—Continued.

3. Application of the Schick test to all children.
4. Immunization by toxin-antitoxin inoculation of all susceptibles.
5. Determination of presence or absence of carriers among contacts and, so far as practicable, in the community at large.

German measles.1. *Infectious agent*: Unknown.2. *Source of infection*: Secretions of the mouth and possibly of the nose.

3. *Mode of transmission*: By direct contact with the patient or with articles freshly soiled with the discharges from the nose or throat of the patient.

4. *Incubation period*: From 10 to 21 days.5. *Period of communicability*: Eight days from onset of the disease.6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms.

2. Isolation—Separation of the patient from nonimmune children and exclusion of the patient from school and public places for the period of presumed infectivity. In the Navy all cases of German measles should be isolated.

3. Immunization—None.

4. Quarantine—None except exclusion of nonimmune children from school and public gatherings from the eleventh to the twenty-second day from date of exposure to a recognized case.

5. Concurrent disinfection—Discharges from the nose and throat of the patient and articles soiled by discharges.

6. Terminal disinfection—Airing and cleaning.

(B) General measures—None.

NOTE.—The reason for attempting to control this disease is that it may be confused with scarlet fever during its early stages; each person having symptoms of the disease therefore should be placed under the care of a physician and the case should be reported to the local department of health.

Influenza.

1. *Infectious agent*: Unknown and disputed. Evidence for and against the *Bacterium influenzae* is conflicting.

2. *Source of infection*: Typical or atypical human cases.

3. *Mode of transmission*: By direct or indirect contact with the patient or with articles freshly soiled with the discharges from the nose or throat of the patient.

4. *Incubation period*: From one to three days.5. *Period of communicability*: Indefinite and uncertain.6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms.

2. Isolation—Separation of patients from susceptibles for the period of their illness.

3. Artificial immunization—In the absence of definite knowledge of the causative organism, there is no scientific basis for the employment of vaccines as a prophylactic measure, a fact which is substantiated by the universal failure of the various bacterins employed for this purpose in 1919. No methods of artificial active or passive immunization are known at present.

4. Quarantine—None.

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

5. *Concurrent disinfection*—Of the secretions of the mouth and nose, and of articles contaminated therewith.

6. *Terminal disinfection*—Cleaning.

(B) General measures—Education of the public in habits of personal cleanliness and in the danger of association or contact with those showing catarrhal symptoms or with cough.

Measles.

1. *Infectious agent*: A filterable virus.

2. *Source of infection*: Buccal and nasal secretions of an infected individual.

3. *Mode of transmission*: Directly from person to person; indirectly through articles freshly soiled with the buccal and nasal discharges of an infected individual. The most easily transmitted of all communicable diseases.

4. *Incubation period*: Seven to 18 days; usually 14 days.

5. *Period of communicability*: During the period of catarrhal symptoms and until the cessation of abnormal mucous membrane secretions—minimum period of seven days; from two days before to five days after the appearance of the rash.

6. *Methods of control*: Measles is more highly communicable than any of the communicable diseases of the respiratory type with the possible exception of influenza. It is a difficult disease to control because it is communicable in the prodromal or preeruptive stage before the disease is recognizable.

(A) The infected individual and his environment—

1. *Recognition of the disease*—As soon as possible by the clinical symptoms, special attention being given to slight rise in temperature, catarrhal inflammation of the throat, nose, and eyes, and Koplik's spots—small bluish-white spots, the size of a pin-head, surrounded by a reddish areola on the mucous membrane of the cheeks and lips.

Early detection of every new case with prompt isolation is the most important of practicable measures for the suppression of an outbreak of measles. Careful daily inspection of the entire personnel, or at least all who possibly could have been exposed, is a very important preventive measure in this connection. All members of the crew should be instructed to report at the sick bay immediately in case any symptom develops which may be a prodrome of measles. Hospital corpsmen, chief petty officers, and petty officers should be on the alert to see that these instructions are carried out. As pointed out by Gatewood, in his *Naval Hygiene*, new cases tend to appear during an outbreak in successive crops at intervals of 11 to 14 days. Special vigilance is indicated toward the end of each interval but inspections should be performed with care at all times.

2. *Isolation*—During period of communicability and for at least seven days after the appearance of the rash. All persons who show presumptive signs of developing the disease also should be isolated promptly. Every person who has a temperature of 99.5° F., cough, coryza, or congestion of the conjunctivæ should be regarded as a suspect.

3. *Management of the case*—Measles patients should be isolated in quarters that can be ventilated adequately and kept uniformly warm. There should be at least 8 feet of separation between

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

3. Management of the case—Continued.

centers of beds, and screens should be placed or strung between beds to facilitate cubicle isolation. In the isolation hospital, patients whose throats show the presence of hæmolytic streptococci should be removed from the general measles ward and isolated in a special group or groups. In any event, patients developing pneumonia should be removed from other cases of measles and treated separately or in a measles-pneumonia ward. Careful bedside disinfection and a rigid cubicle system technique of asepsis should be practiced in all cases, including the invariable use of caps and gowns and immediate disinfection of the hands of the medical officer, hospital corpsman, or other person each time after coming in contact with the case. Flies must be excluded. Separate gowns should be used for attendance upon different patients or different groups of patients, and gowns should be kept clean by frequent sterilization. It is only by minute attention to details that cross infection in hospital can be prevented. In view of susceptibility to pneumonia, measles patients should be kept in bed for five days after the temperature has returned to normal, and they should be retained in hospital, in a convalescent ward, perhaps, for at least 10 days after convalescence is established. As a general policy, measles patients should be transferred promptly to hospital. However, in cold and stormy weather a long ambulance ride or transfer by boat involves considerable risk. Should it be impracticable to avoid such risk the patient should be clad warmly; every effort should be made to protect him from exposure and to prevent chilling.

4. Immunization—None.

5. Quarantine—In civil practice when the exposure has occurred in the same household, children who have not had measles should be excluded from school until 18 days have elapsed since appearance of the rash in the last case. It is permissible in accordance with modern ideas to allow a susceptible child to continue at school for seven days after the date of appearance of earliest symptoms in the first case to which exposed; or, in the event of a single known exposure, for seven days from that time. The same practice should be followed in the case of a susceptible teacher who has been exposed to the disease. It is good practice to restrict the movements of other susceptible adults, known to have been exposed to measles, during the last few days of the incubation period. While often impracticable in civil public health work, this measure usually can be applied in the Navy and among its civilian employees. Exposed susceptible persons also should be excluded from all public gatherings during the 14-day incubation period. Quarantine of naval vessels or naval stations in which measles has occurred is unnecessary. Definitely determined susceptible contacts may be quarantined within the organization. At naval training stations, companies of recruits under training, in which a case of measles appears, should be segregated from other companies, and actual contacts should be separated from the rest of the unit.

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

6. Concurrent disinfection—All articles soiled with secretions of the nose and throat.
7. Terminal disinfection—Thorough cleansing, airing, and sunning of the room occupied by a patient with this disease is all that is necessary. Terminal fumigation is of little or no value, as the virus of measles does not withstand drying or live long on fomites. After 14 days have elapsed there is little danger in occupying rooms previously occupied by measles patients.

(B) General measures—

1. Daily examination of exposed persons and of persons possibly exposed. A nonimmune person exhibiting a rise of temperature of 1° or more should be isolated at once pending diagnosis.
2. Where daily observation of school children by a physician or nurse is practicable, schools should not be closed or classes discontinued. Similar rules should apply in handling enlisted men; it should not be necessary to interfere with drills and routine training.
3. Education of the public as to the danger of exposing young children to those exhibiting acute catarrhal symptoms of any kind.
4. In naval organizations when measles occurs, or is liable to be introduced, the personnel should be acquainted with the nature of the disease, the character of its prodromal symptoms, and the measures necessary to prevent its spread. All necessary instructions should be given to the crew verbally and posted on the bulletin board. Attention should be paid to the sterilization of mess gear and avoidance of the use of drinking utensils and other articles in common.

Mumps.

1. *Infective organism*: Unknown.

2. *Source of infection*: Secretions of the mouth and possibly of the nose.

3. *Mode of transmission*: By direct contact with an infected person or with articles freshly soiled with the discharges from the nose or throat of such infected persons.

4. *Incubation period*: From 12 to 26 days. The most common period, 18 days, accepted as usual. A period of 21 days is not uncommon.

5. *Period of communicability*: Unknown, but assumed to persist until the parotid gland has returned to its normal size.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Inflammation of Steno's duct may be of assistance in recognizing the early stage of the disease. The diagnosis usually is made on swelling of the parotid gland.
2. Isolation—Separation of the patient from nonimmune children and exclusion of the patient from school and public places for the period of presumed infectivity.
3. Immunization—None.
4. Quarantine—Limited to exclusion of nonimmune children from school and public gatherings for 21 days after last exposure to a recognized case.
5. Concurrent disinfection—All articles soiled with the discharges from the nose and throat of the patient.
6. Terminal disinfection—None.

(B) General measures—None.

Pneumonia.

1. *Infectious agent*: Various pathogenic bacteria commonly found in the nose, throat, and mouth, such as the pneumococcus, the bacillus of Freidländer, the influenza bacillus, etc.

2. *Source of infection*: Discharges from the mouth and nose of apparently healthy carriers, as well as of recognized infected individuals, and articles freshly soiled with such discharges.

3. *Mode of transmission*: By direct contact with an infected person, or with articles freshly soiled with the discharges from the nose or throat of, and possibly from infected dust or rooms occupied by, infected person.

4. *Incubation period*: Short, usually two to three days.

5. *Period of communicability*: Unknown; presumably until the mouth and nasal discharges no longer carry the infectious agent in an abundant amount or in a virulent form.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms. Specific infecting organisms may be determined by serological and bacteriological tests early in the course of the disease.

2. Isolation—Patient during clinical course of the disease.

3. Immunization—None; vaccines are worthy of further careful trial.

4. Quarantine—None.

5. Concurrent disinfection—Discharges from the nose and throat of the patient.

6. Terminal disinfection—Thorough cleaning, airing, and sunning.

(B) General measures—In institutions and camps, when practicable, people in large numbers should not be congregated closely within doors. The general resistance should be conserved by getting good feeding, fresh air, temperance in the use of alcoholic beverages, and other hygienic measures.

NOTE.—The early reporting of pneumonia is highly desirable in view of its communicability and the possibility of effective treatment of certain types with curative serums.

Scarlet fever.

1. *Infectious agent*: Unknown.

2. *Source of infection*: The belief at present is that the virus is contained in the secretions from the nose and throat, in the blood, and in the lymph nodes, and that it is given off in the discharges from the mouth, the nose, the ears, and from broken-down glands of infected persons.

3. *Mode of transmission*: Directly by personal contact with an infected person; indirectly by articles freshly soiled, with discharges of an infected person, or through contaminated milk.

4. *Incubation period*: Two to seven days, usually three or four days.

5. *Period of communicability*: Four weeks from the onset of the disease, without regard to desquamation, and until all abnormal discharges have stopped and all open sores have healed.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—By clinical symptoms.

2. Isolation—In home or hospital, maintained in each case until the end of the period of infectivity.

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

3. *Quarantine*—Exclusion of exposed susceptible children and teachers from school, and food handlers from their work, until seven days have elapsed since last exposure to a recognized case. In the Navy it is not considered necessary to quarantine groups of men who have been exposed to an infected individual.
4. *Concurrent disinfection*—Of all articles which have been in contact with a patient and all articles soiled with discharges of the patient.
5. *Terminal disinfection*—Thorough cleaning.

(B) General measures:

1. Daily examination of exposed children and of other possibly exposed persons for a week after last exposure.
2. Schools should not be closed where daily observation of the children by a physician or nurse can be provided for.
3. Education as to special danger of exposing young children to those exhibiting acute catarrhal symptoms of any kind.
4. Pasteurization of milk supply.

Septic sore throat.

1. *Infectious agent*: Streptococcus (hæmolytic type).

2. *Source of infection*: The human nasopharynx, usually the tonsils, any case of acute streptococcus inflammation of these structures being a potential source of infection, including the period of convalescence of such cases. The udder of a cow infected by the milker is an occasional source of infection. In such udders the physical signs of mastitis are usually absent.

3. *Mode of transmission*: Direct or indirect human contact; consumption of raw milk from an infected udder.

4. *Incubation period*: One to three days.

5. *Period of communicability*: In man, presumably during the continuance of clinical symptoms; in the cow, during the continuance of discharge of the streptococci in the milk, the condition in the udder tending to a spontaneous subsidence. The carrier stage may follow convalescence and persist for some time.

6. *Methods of control*:

(A) The infected individual and his environment—

1. *Recognition of the disease*—Clinical symptoms. Bacteriological examination of the lesions or discharges from the tonsils and nasopharynx may be useful.
2. *Isolation*—During the clinical course of the disease and convalescence, and particularly exclusion of the patient from participation in the production or handling of milk or milk products.
3. *Immunization*—None.
4. *Quarantine*—None.
5. *Concurrent disinfection*—Articles soiled with discharges from the nose and throat of the patient.
6. *Terminal disinfection*—Cleaning.

(B) General measures—

1. Exclusion of suspected milk supply from public sale or use until pasteurized. The exclusion of the milk of an infected cow or cows in small herds is possible when based on bacteriological examination of the milk of each cow, and preferably the milk from each quarter of the udder at frequent intervals.
2. Pasteurization of all milk.
3. Education in the principles of personal hygiene and avoidance of the use of common towels, drinking and eating utensils.

Tuberculosis (pulmonary).

1. *Infectious agent:* *Bacillus tuberculosis* (human). (In rare instances the bovine tubercle bacillus has been proved to be the cause of a pulmonary tuberculosis.)

2. *Source of infection:* The specific organism present in the discharges, or articles freshly soiled with the discharges from any open tuberculous lesions, the most important discharge being sputum. Of less importance are discharges from the intestinal and genito-urinary tracts, or from lesions of the lymphatic glands, bone, and skin.

3. *Mode of transmission:* Direct or indirect contact with an infected person by coughing, sneezing, or other droplet infection, kissing, common use of unsterilized food utensils, pipes, toys, drinking cups, etc., and possibly by contaminated flies and dust.

4. *Incubation period:* Variable and dependent upon the type of the disease.

5. *Period of communicability:* Exists as long as the specific organism is eliminated by the host. Commences when a lesion becomes an open one—i. e., discharging tubercle bacilli—and continues until it heals or death occurs.

6. *Methods of control:*

(A) The infected individual and his environment—

1. Recognition of the disease—By clinical symptoms and by thorough physical examination, confirmed by bacteriological examination and by serological tests.
2. Isolation of such “open” cases as do not observe the precaution necessary to prevent the spread of the disease.
3. Immunization—None.
4. Quarantine—None.
5. Concurrent disinfection of sputum and articles soiled with it. Particular attention should be paid to prompt disposal or disinfection of sputum itself, of handkerchiefs, cloths, or paper soiled therewith, and of eating utensils used by the patient.
6. Terminal disinfection—Cleaning and renovation.

(B) General measures—

1. Education of the public in regard to the dangers of tuberculosis and the methods of control, with especial stress upon the danger of exposure and infection in early childhood.
2. Provision of dispensaries and visiting-nurse service for discovery of early cases and supervision of home cases.
3. Provision of hospitals for isolation of advanced cases and sanatoria for the treatment of early cases.
4. Provision of open-air schools and preventoria for pretuberculous children.
5. Improvement of housing conditions and the nutrition of the poor.
6. Ventilation and elimination of dusts in industrial establishments and places of public assembly.
7. Improvement of habits of personal hygiene and betterment of general living conditions.
8. Separation of babies from tuberculous mothers at birth.

Tuberculosis (other than pulmonary).

1. *Infectious agent:* *Bacillus tuberculosis* (human and bovine).

2. *Source of infection:* Discharges from mouth, nose, bowels, and genito-urinary tract of infected humans; articles freshly soiled with such discharges; milk from tuberculous cattle; rarely the discharging lesion of bones, joints, and lymph nodes.

3. *Mode of transmission*: By direct contact with infected persons, by contaminated food, and possibly by contact with articles freshly soiled with the discharges of infected persons.

4. *Incubation period*: Unknown.

5. *Period of communicability*: Until lesions are healed.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms confirmed by bacteriological and serological examinations.

2. Isolation—None.

3. Immunization—None.

4. Quarantine—None.

5. Concurrent disinfection—Discharges and articles freshly soiled with them.

6. Terminal disinfection—Cleaning.

(B) General measures—

1. Pasteurization of milk and inspection of meats.

2. Eradication of tuberculous cows from milch herds used in supplying raw milk.

3. Patients with open lesions should be prohibited from handling foods which are consumed raw.

Whooping cough.

1. *Infectious agent*: *Bacillus pertussis* (Bordet-Gengou).

2. *Source of infection*: Discharges from the laryngeal and bronchial mucous membranes of infected persons (sometimes also of infected dogs and cats, which are known to be susceptible).

3. *Mode of transmission*: Contact with an infected person or animal or with articles freshly soiled with the discharges of such person or animal.

4. *Incubation period*: Within 14 days.

5. *Period of communicability*: Particularly communicated in the early catarrhal stages before the characteristic whoop makes the clinical diagnosis possible. Communicability probably persists not longer than two weeks after the development of the characteristic whoop or approximately four weeks after the onset of catarrhal symptoms.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, supported by a differential leucocyte count, and confirmed where possible by bacteriological examination of bronchial secretions.

2. Isolation—Separation of the patient from susceptible children, and exclusion of the patient from school and public places for the period of presumed infectivity.

3. Immunization—Use of prophylactic vaccination recommended by some observers. Not effective in all cases.

4. Quarantine—Limited to the exclusion of nonimmune children from school and public gatherings for 14 days after their last exposure to a recognized case.

5. Concurrent disinfection—Discharges from the nose and throat of the patient and articles soiled with such discharges.

6. Terminal disinfection—Cleaning of the premises used by the patient.

6. *Methods of control*—Continued.

- (B) General measures—Education in habits of personal cleanliness and in the dangers of association or contact with those showing catarrhal symptoms with cough.

GROUP II. DISEASES TRANSMITTED BY DISCHARGES FROM THE INTESTINAL TRACT.

- * Typhoid fever.
- * Paratyphoid fever.
- * Hookworm disease.

- * Dysentery, bacillary.
- * Dysentery, amœbic.
- * Cholera, Asiatic.

NOTE.—Those diseases marked with asterisk are discussed.

Cholera.

1. *Infectious agent*: *Spirillum cholerae asiaticæ*.
2. *Source of infection*: Bowel discharges and vomitus of infected persons, and faeces of convalescent or healthy carriers. Ten per cent of contacts may be found to be carriers.
3. *Mode of transmission*: By food and water polluted by the infective agent; by contact with infected persons, carriers, or articles freshly soiled by their discharges; by flies.
4. *Incubation period*: One to five, usually three, days, occasionally longer if the healthy-carrier stage, before development of symptoms, is included.
5. *Period of communicability*: Usually 7 to 14 days or longer and until the infective organism is absent from the bowel discharges.
6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by bacteriological examination.
2. Isolation of patient in hospital or screened room.
3. Immunization by vaccination may be of value.
4. Quarantine—Contacts for five days from last exposure, or longer if stools are found to contain the cholera vibrio.
5. Concurrent disinfection—Prompt and thorough disinfection of the stools and vomited matter. Articles used by and in connection with the patient must be disinfected before removal from the room. Food left by the patient should be burned.
6. Terminal disinfection—Bodies of those dying from cholera should be cremated, if practicable, or otherwise wrapped in a sheet wet with disinfectant solution and placed in water-tight caskets. The room in which a sick patient was isolated should be thoroughly cleaned and disinfected.

(B) General measures—

1. Rigid personal prophylaxis of attendants by scrupulous cleanliness, disinfection of hands each time after handling patient or touching articles contaminated by dejecta, the avoidance of eating or drinking anything in the room of the patient, and the prohibition of those attendant on the sick from entering the kitchen.
2. The bacteriological examination of the stools of all contacts to determine carriers. Isolation of carriers.
3. Water should be boiled, if used for drinking or toilet purposes, or if used in washing dishes or food containers, unless the water supply is adequately protected against contamination or is so treated, as by chlorination, that the cholera vibrio can not survive in it.

6. *Methods of control*—Continued.

(B) General measures—Continued.

4. Careful supervision of food and drink. Where cholera is prevalent, only cooked foods should be used. Food and drink after cooking or boiling should be protected against contamination, as by flies and human handling.

(C) Epidemic measures—Inspection service for early detection and isolation of cases; examination of persons exposed in infected centers for detection of carriers, with isolation or control of carriers; disinfection of rooms occupied by the sick; and the detention, in suitable camps for five days, of those desirous of leaving for another locality. Those so detained should be examined for detection of carriers.

Dysentery (amœbic).

1. *Infectious agent*: *Amœba histolytica*.
2. *Source of infection*: The bowel discharges of infected persons.
3. *Mode of transmission*: By drinking contaminated water, and by eating infected foods, and by hand-to-mouth transfer of infected material; from objects soiled with discharges of an infected individual, or of a carrier, by flies.
4. *Incubation period*: Unknown.
5. *Period of communicability*: During course of disease and until repeated microscopic examination of stools shows absence of *Amœba histolytica*.
6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms confirmed by microscopic examination of stools.
2. Isolation—None.
3. Immunization—None.
4. Quarantine—None.
5. Concurrent disinfection of the bowel discharges.
6. Terminal disinfection—Cleaning.

(B) General measures—

1. Boil drinking water, unless the supply is known to be free from contamination.
2. Water supply should be protected against contamination and supervision should be exercised over all foods eaten raw.

Dysentery (bacillary).

1. *Infectious agent*: *Bacillus dysenteriae*.
2. *Source of infection*: The bowel discharges of infected persons.
3. *Mode of transmission*: By drinking contaminated water, and by eating infected foods, and by hand-to-mouth transfer of infected material; from objects soiled with discharges of an infected individual, or of a carrier, by flies.
4. *Incubation period*: Two to seven days.
5. *Period of communicability*: During the febrile period of the disease and until the organism is absent from the bowel discharges.
6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms confirmed by serological and bacteriological tests.
2. Isolation—Infected individuals during the communicable period of the disease.

6. Methods of control—Continued.

(A) The infected individual and his environment—Continued.

3. Immunization—Vaccines give considerable immunity. Owing to severe reactions their use is not universal, nor should it be made compulsory except under extreme emergency.
4. Quarantine—None.
5. Concurrent disinfection—Bowel discharges.
6. Terminal disinfection—Cleaning.

(B) General measures—

1. Rigid personal prophylaxis of attendants upon infected persons.
2. No milk or food for human consumption should be sold from a place occupied by a patient unless the persons engaged therein occupy quarters separate from the house where the patient is sick, and all utensils used are cleaned and kept in a separate building, and under a permit from the health officer.
3. All attendants upon persons affected with this disease should be prohibited from having anything to do with the handling of food.
4. Necessary precautions against flies.

Hookworm disease.

1. *Infectious agent*: *Anchylostoma* (*Necator americanus*). (See p. 515.)

2. *Sources of infection*: Fæces of infected persons. Infection generally takes place through the skin, occasionally by the mouth.

3. *Mode of transmission*: The larval forms pierce the skin, usually of the foot, and passing through the lymphatics to the vena cava and the right heart, thence in the blood stream to the lungs, they pierce the capillary walls and pass into the alveoli. Then they pass up the bronchi and trachea to the throat, whence they are swallowed and finally lodge in the small intestine. Also by drinking water containing larvæ, by eating soiled food, by hand to mouth transmission of the eggs or larvæ from objects soiled with infected discharges.

4. *Incubation period*: Seven to ten weeks.

5. *Period of communicability*: As long as the parasite or its ova are found in the bowel discharges of an infected individual. Contaminated soil remains infective for five months in the absence of freezing.

6. Methods of control:

(A) The infected individual and his environment—

1. Recognition of the disease—Microscopic examination of bowel discharges.
2. Isolation—None.
3. Immunization—None.
4. Quarantine—None.
5. Concurrent disinfection—Sanitary disposal of bowel discharges.
6. Terminal disinfection—None.
7. Treatment—Appropriate treatment of infected individual to rid the intestinal canal of the parasite and its ova.
8. Examination of all men recruited from the Southern States and the Philippines.

(B) General measures—

1. Education as to dangers of soil pollution.
2. Prevention of soil pollution by installation of sanitary disposal systems for human discharges.
3. Personal prophylaxis by cleanliness and the wearing of shoes.

Paratyphoid fever.

1. *Infectious agent:* *Bacillus paratyphosus* A or B.
2. *Source of infection:* Bowel discharges and urine of infected persons, and foods contaminated with such discharges of infected persons or of healthy carriers. Healthy carriers may be numerous in an outbreak.
3. *Mode of transmission:* Directly by personal contact; indirectly by contact with articles freshly soiled with the discharges of infected persons or through milk, water, or food contaminated by such discharges.
4. *Incubation period:* Four to ten days; average, seven days.
5. *Period of communicability:* From the appearance of prodromal symptoms, throughout the illness and relapses, during convalescence, and until repeated bacteriological examinations of discharges show absence of the infecting organism.

6. Methods of control:**(A) The infected individual and his environment—**

1. Recognition of the disease—Clinical symptoms, confirmed by specific agglutination test, and by bacteriological examination of blood, bowel discharges, or urine.
2. Isolation—In fly-proof room, preferably under hospital conditions, of such cases as can not command adequate sanitary environment and nursing care in their homes.
3. Immunization of exposed susceptibles—Navy regulations require that all men shall be immunized against paratyphoid fever.
4. Quarantine—None.
5. Concurrent disinfection—Disinfection of all bowel and urinary discharges and articles soiled with them.
6. Terminal disinfection—Cleaning.

(B) General measures—

1. Purification of public water supplies.
2. Pasteurization of public milk supplies.
3. Supervision of other food supplies and of food handlers.
4. Prevention of fly breeding.
5. Sanitary disposal of human excreta.
6. Extension of immunization by vaccination as far as practicable.
7. Supervision of paratyphoid carriers and their exclusion from the handling of foods.
8. Systematic examination of fecal specimens from those who have been in contact with recognized cases to detect carriers.
9. Exclusion of suspected milk supplies pending discovery of the person or other cause of contamination of the milk.
10. Exclusion of water supply, if contaminated, until adequately treated with hypochlorite or other efficient disinfectant, or unless all water used for toilet, cooking, and drinking purposes is boiled before use. (See p. 291.)

Typhoid fever.

1. *Infectious agent:* *Bacillus typhosus*.
2. *Source of infection:* Fæcal discharges and urine of infected individuals. Healthy carriers are common.
3. *Mode of transmission:* Conveyance of the specific organism by direct or indirect contact with a source of infection. Among indirect means of transmission are contaminated water, milk, and shellfish. Contaminated flies have been common means of transmission in epidemics.
4. *Incubation period:* From 7 to 21 days, averaging 10 to 14 days.

5. *Period of communicability*: From the appearance of prodromal symptoms throughout the illness and relapses during convalescence and until repeated bacteriological examinations of the discharges show persistent absence of the infecting organism.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by specific agglutination test and bacteriological examination of blood, bowel discharges, or urine.
2. Isolation—In fly-proof room, preferably under hospital conditions, of such cases as can not command adequate sanitary environment and nursing care in their homes.
3. Immunization—Of susceptibles who are known to have been exposed or are suspected of having been exposed. Navy regulations require that all men shall be immunized against typhoid fever.
4. Quarantine—None.
5. Concurrent disinfection—Disinfection of all bowel and urinary discharges and articles soiled with them.
6. Terminal disinfection—Cleaning.

(B) General measures—

1. Purification of public water supplies.
2. Pasteurization of public milk supplies.
3. Supervision of other food supplies and of food handlers.
4. Prevention of fly breeding.
5. Sanitary disposal of human excreta.
6. Extension of immunization by vaccination as far as practicable.
7. Supervision of typhoid carriers and their exclusion from the handling of foods.
8. Systematic examination of fecal specimens from those who have been in contact with recognized cases to detect carriers.
9. Exclusion of suspected milk supplies pending discovery of the person or other cause of contamination of the milk.
10. Exclusion of water supply, if contaminated, until adequately treated with hypochlorite or other efficient disinfectant, or unless all water used for toilet, cooking, and drinking purposes is boiled before use.

GROUP III. DISEASES TRANSMITTED BY INSECTS AND OTHER ARTHROPODS.

* Dengue.
* Malaria.

* Plague.
* Typhus fever.
* Yellow fever.
Filariasis.
Trench fever.

Relapsing fever
Pappataci fever.
Oriental sore.
Tsutugamuchi fever.
Kala-azar.
Histoplasmosis.
Rocky Mountain spotted fever.

NOTE.—Those diseases marked with asterisk are discussed.

Dengue.

1. *Infectious agent*: Unknown.
2. *Source of infection*: The blood of infected persons.
3. *Mode of transmission*: By the bite of infected mosquitoes, probably *Aedes aegypti* (perhaps also *Culex quinquefasciatus*).
4. *Incubation period*: Four to five days.

5. *Period of communicability*: During the febrile stage of the disease.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms.
2. Isolation—The patient must be kept in a screened room and under mosquito nets.
3. Immunization—None.
4. Quarantine—None.
5. Concurrent disinfection—None.
6. Terminal disinfection—None. Upon termination of the case fumigation of the room and house to destroy mosquitoes.

(B) General measures—

Measures directed toward the elimination of mosquitoes. Screening of rooms. (See "Malaria.")

Malaria.

1. *Infectious agent*: The several species of malarial organisms. (See section on Animal Parasites of Man.)

2. *Source of infection*: The blood of an infected individual.

3. *Mode of transmission*: By bite of the infected anopheles mosquito. The mosquito is infected by biting an individual suffering from acute or chronic malaria. The parasite develops in the body of the mosquito for 10 to 14 days, after which time the sporozoites appear in its salivary glands.

4. *Incubation period*: Varies with the type of species of infecting organism and the amount of infection; usually 14 days in the tertian variety.

5. *Period of communicability*: As long as the malaria organism exists in the blood.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, always to be confirmed by microscopical examination of the blood.
2. Isolation—Use of mosquito nets by patient until blood is free of malarial parasites.
3. Immunization—None.
4. Quarantine—None.
5. Concurrent disinfection—None. Destroy by capture or swatting all mosquitoes in the sick room.

(B) General measures—

1. Search for carriers by examination of blood smears.
2. Screen sleeping and living quarters.
3. Kill mosquitoes in living quarters. (See pp. 268, 270, 273.)
4. Destruction of mosquito breeding places by—
 - (a) Drainage.
 - (b) Training of watercourses.
 - (c) Filling.
5. Destruction of mosquito larvæ.
 - (a) Application of thin films of oil to surface of water (by drip can or spraying crude oil is best).
 - (b) Stocking swamps and pools with species of fish that will eat the mosquito larvæ.
 - (c) Application of Paris green to the surface of the water.

Plague (bubonic, septicæmic, pneumonic).

1. *Infectious agent*: *Bacillus pestis*.
2. *Source of infection*: Blood of infected persons and animals and sputum of human cases of plague pneumonia.
3. *Mode of transmission*: Direct in the pneumonic form. In other forms the disease generally is transmitted by the bites of fleas (*Xenopsylla cheopis* and *Ceratophyllus fasciatus*), by which the disease is carried from rats to man; also by fleas from other rodents. Accidental, by inoculation, or by the bites of infected animals. Bedbugs may transmit the infection; flies possibly may convey the infection.
4. *Incubation period*: Commonly from 3 to 7 days, although occasionally prolonged to 8 or even 14 days.
5. *Period of communicability*: Until convalescence is well established, period undetermined.
6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by bacteriological examination of blood, pus from glandular lesion, or sputum.
2. Isolation—Patient in hospital if practicable; if not, in a screened room which is free from vermin.
3. Immunization—Passive immunization of known exposed contacts; active immunization of those who may be exposed.
4. Quarantine—Contacts for seven days.
5. Concurrent disinfection—All discharges and articles freshly soiled therewith.
6. Terminal disinfection—Thorough cleaning followed by thorough disinfection.

(B) General measures—

1. Extermination of rats and vermin by use of known methods for their destruction; destruction of rats on ships arriving from infected ports; examination of rats, ground squirrels, etc., in areas where the infection persists, for evidence of endemic prevalence of the disease among them.
2. Supervision of autopsies of all deaths during epidemics.
3. Supervision of the disposal of the dead during epidemics, whether by burial, transfer, or holding in vault, whatever the cause of death.
4. Cremation or burial in quicklime of those dying of this disease.

Typhus fever.

1. *Infectious agent*: Not yet definitely determined.
2. *Source of infection*: The blood of infected individuals.
3. *Mode of transmission*: Infectious agent transmitted by lice.
4. *Incubation period*: Five to twenty days; usually twelve days.
5. *Period of communicability*: Until 36 hours have elapsed after the temperature reaches normal.
6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms. (Confirmation by bacteriological examination of blood is claimed by Plotz.) Finding of Rickettsia bodies.
2. Isolation—In a vermin-free room. All attendants should wear vermin-proof clothing.

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

3. Immunization—Claimed to be practicable by use of vaccine (Plotz, Olitzky, and Baehr). Not yet generally accepted.
4. Quarantine—Exposed susceptibles for 12 days after last exposure.
5. Concurrent disinfection—None.
6. Terminal disinfection—Destroy all vermin and vermin eggs on body of patient, if not already accomplished. Destroy all vermin and eggs on clothing. Rooms to be rendered free from vermin.

(B) General measures—Delousing of persons, clothing, and premises during epidemics, or when they have come or have been brought into an uninfected place from an infected community.

Yellow fever.

1. *Infectious agent*: *Leptospira icteroides*.
2. *Source of infection*: The blood of infected persons.
3. *Mode of transmission*: By the bite of infected *aedes ægypti* mosquitoes.
4. *Incubation period*: Three to five days; occasionally six days.
5. *Period of communicability*: First three days of the fever.
6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms.
2. Isolation—Isolate from mosquitoes in a special hospital ward or thoroughly screened rooms. If necessary, the room or ward should be freed from mosquitoes by fumigation. Isolation necessary only for the first three days of the fever.
3. Immunization—None. Noguchi claims that he has produced a serum which has value as an immunizing agent.
4. Quarantine—Contacts for six days.
5. Concurrent disinfection—None.
6. Terminal disinfection—None. Upon termination of case the premises should be rendered free from mosquitoes by fumigation.

(B) General measures—

1. See general measures for malaria.
2. Since the habits of *aedes ægypti* differ from those of anophelines, some difference in the water accumulations attacked must be noted. The *aedes ægypti* is a species that lives closely in association with man, breeding largely in artificial accumulations of water close to dwellings, such as cisterns, barrels, and cans. It is diurnal (daytime) in its first feeding and later nocturnal. It is never found in marshes or swamps, so that attention need not be given to these unless a simultaneous attack on malaria is also desired.

GROUP IV. DISEASES TRANSMITTED BY DIRECT CONTACT.

* Venereal diseases.

Yaws.

| Impetigo contagiosa.

| Ring worm.

NOTE.—Those diseases marked with asterisk are discussed.

Chancroid.

1. *Infectious agent*: *Bacterium ulceris chancroci*.
2. *Source of infection*: Pus and secretion from the chancroid itself.
3. *Mode of transmission*: By direct contact with infected persons. Almost invariably through sexual intercourse. Possibly in other ways. Indirectly as mentioned in syphilis.
4. *Incubation period*: Usually within 5 days; always within 10 days.

5. *Period of communicability*: During continuance of specific organism and lesion.

6. *Method of control*:

(A) The infected individual and his environment—Same as for syphilis.

(B) General measures—Same as for syphilis.

Gonorrhœa.

1. *Infectious agent*: Gonococcus.

2. *Source of infection*: Discharges from lesions or inflamed mucous membranes and glands of infected persons, viz., urethral, vaginal, cervical, conjunctival mucous membranes, and Bartholin's or Skene's glands in the female, and Cowper's and the prostate glands in the male.

3. *Mode of transmission*: By direct personal contact with infected persons, almost invariably through sexual intercourse, and indirectly by contact with articles freshly soiled with the discharges of such persons.

4. *Incubation period*: One to eight days, usually three to five days.

5. *Period of communicability*: As long as the gonococcus persists in any of the discharges, whether the infection be an old or a recent one.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by bacteriological examination or serum reaction.

2. Isolation—When the lesions are in the genito-urinary tract, exclusion from sexual contact, and when the lesions are conjunctival, exclusion from school or contact with children, as long as the discharges contain the infecting organism. In the Navy restriction of liberty until gonococcus disappears from discharges.

3. Immunization—None.

4. Quarantine—None.

5. Concurrent disinfection—Discharges from lesions and articles soiled therewith.

6. Terminal disinfection—None.

(B) General measures—

1. Education in matters of sex hygiene, particularly as to the fact that continence in both sexes at all ages is compatible with health and development.

2. Provision for accurate and early diagnosis, and treatment in hospitals and dispensaries of infected persons with consideration for privacy of record and provision for following cases until cured.

3. Repression of prostitution by use of police power and control of use of living premises.

4. Restriction of sale of alcoholic beverages.

5. Restrictions of advertising of services or medicines for the treatment of sex diseases, etc.

6. Elimination of common towels and toilet articles from public places.

7. Use of prophylactic silver solution in the eyes of the new born.

8. Exclusion of persons in the communicable stage of the disease from participation in the preparing and serving of food.

6. *Methods of control*—Continued.

(B) General measures—Continued.

9. Personal prophylaxis should be advised to those who expose themselves to opportunity for infection. In the Navy personal prophylaxis is given in the following manner:

- (a) Prophylactic tubes containing calomel 33, camphor 2, phenol 3, anhydrous lanolin 39, benzoinated lard 20, and beeswax 3, to be used immediately after exposure, are furnished upon application.

- (b) Ship's prophylaxis given in the following manner:

1. Thoroughly wash the parts with soap and water, and then with a 1:5,000 solution of bichloride of mercury.
2. Instruct the man to pass urine before taking prophylactic treatment.
3. Inject 2 per cent protargol solution (or 10 per cent argyrol or 10 per cent silvol) into anterior urethra with syringe and hold meatus closed for five minutes. (About one-half fluidounce of solution used.)
4. Thoroughly apply a liberal amount of calomel ointment (33 per cent calomel powder by weight in adeps lanæ hydrosus) to penis and scrotum.
5. Instruct the man not to wash or wipe the ointment off for several hours.

Syphilis.

1. *Infectious agent: Treponema pallidum.*

2. *Source of infection:* Discharges from the lesions of the skin and mucous membranes, and the blood of infected persons, and articles freshly soiled with such discharges or blood in which the *Treponema pallidum* is present.

3. *Mode of transmission:* By direct personal contact with infected persons, usually through sexual intercourse, and indirectly by contact with discharges from lesions or with the blood of such persons.

4. *Incubation period:* About three weeks. (In rare instances reported to have been as long as 70 days.)

5. *Period of communicability:* As long as the lesions are open upon the skin or mucous membranes and until the body is freed from the infecting organisms, as shown by microscopic examination of material from ulcers and by serum reaction.

6. *Methods of control:*

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by microscopical examination of discharges and by serum reactions.
2. Isolation—Exclusion from sexual contact and from preparation or serving of food during the early and active period of the disease; otherwise none, unless the patient is unwilling to heed or is incapable of observing the precautions required by the medical adviser. In the Navy restriction of men's liberty must be enforced as long as there are open lesions.
3. Immunization—None.
4. Quarantine—None.
5. Concurrent disinfection—Of discharges and of articles soiled therewith, including mess gear.
6. Terminal disinfection—None.

6. *Methods of control*—Continued.

(B) General measures—

1. Education in matters of sexual hygiene, particularly as to the fact that continence in both sexes at all ages is compatible with health and development.
2. Provision for accurate and early diagnosis and treatment, in hospitals and dispensaries, of infected persons, with consideration for privacy of record, and provision for following cases until cured.
3. Repression of prostitution by use of the police power and control of use of living premises.
4. Restriction of sale of alcoholic beverages.
5. Restriction of advertising of services or medicine for treatment of sex diseases, etc.
6. Abandonment of the use of common towels, cups, and toilet articles and eating utensils, unless sterilized after use.
7. Exclusion of persons in the communicable stage of the disease from participation in the preparing and serving of food.
8. Personal prophylaxis should be advised to those who expose themselves to opportunity to infection. Personal prophylaxis in the Navy is given in the following manner:

(a) See "gonorrhœa," page 259.

(b) See "gonorrhœa," page 259.

GROUP V. DISEASES OF LOWER ANIMALS WHICH MAY BE TRANSMITTED TO MAN.

* Rabies.
Glanders.
Anthrax.
Malta fever.

Foot-and-mouth-disease.
Actinomycosis.
Milk sickness.
* Trichinosis.

NOTE.—Those diseases marked with asterisk are discussed.

Rabies.

1. *Infectious agent*: Unknown.
2. *Source of infection*: Saliva of infected animals, chiefly dogs.
3. *Mode of transmission*: Inoculation with saliva of infected animals through abrasion of skin or mucous membrane, almost always by bites or scratches.
4. *Incubation period*: Usually two or six weeks. May be prolonged to six months or even longer.
5. *Period of communicability*: For 15 days in the dog (not known in man) before the onset of clinical symptoms and throughout the clinical course of the disease.

6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by the presence of Negri bodies in the brain of an infected animal, or by animal inoculations with material from the brain of such infected animal.
2. Isolation—None if patient is under adequate medical supervision and the immediate attendants are warned of possibility of inoculation by human virus.
3. Immunization—Preventive vaccination (Pasteur treatment) after exposure to infection by inoculation.
4. Quarantine—None.

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

5. Concurrent disinfection of saliva of patient and articles soiled therewith.

6. Terminal disinfection—Thorough cleaning.

(B) General measures—

1. Muzzling of dogs when on public streets or in places to which the public has access.

2. Detention and examination of dogs suspected of having rabies.

3. Immediate antirabic treatment of people bitten by dogs or by other animals suspected or known to have rabies, unless the animal is proved not to be rabid by subsequent observation or by microscopic examination of the brain and cord.

Trichinosis.1. *Infectious agent*: *Trichinella spiralis*.2. *Source of infection*: Uncooked or insufficiently cooked meat of infected hogs.3. *Mode of transmission*: Consumption of undercooked infected pork products.4. *Incubation period*: Variable; usually about one week.5. *Period of communicability*: Disease is not transmitted by human host.6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms, confirmed by microscopical examination of muscle tissue containing trichinæ.

2. Isolation—None.

3. Immunization—None.

4. Quarantine—None.

5. Concurrent disinfection—Sanitary disposal of the feces of the patient.

6. Terminal disinfection—None.

(B) General measures—

1. Inspection of pork products for the detection of trichinosis.

2. Thorough cooking of all pork products at a temperature of 100° F. or over.

GROUP VI. MISCELLANEOUS DISEASES.

* Chicken pox.

* Smallpox.

* Tetanus.

* Trachoma.

NOTE.—Those diseases marked with asterisk are discussed.

Chicken pox.1. *Infectious agent*: Unknown.2. *Source of infection*: The infectious agent is presumably present in the lesions of the skin and of the mucous membranes; the latter appearing early and rupturing as soon as they appear, render the disease communicable early, that is, before the exanthem is in evidence.3. *Mode of transmission*: Directly from person to person; indirectly through articles freshly soiled by discharges from an infected individual.4. *Incubation period*: Two to three weeks.5. *Period of communicability*: Until the primary scabs have disappeared from the mucous membranes and the skin.6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms. The differential diagnosis of this disease from smallpox is important, especially in people over 15 years of age.

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

2. Isolation—Exclusion of patient from school, and prevention of contact with nonimmune persons.

3. Immunization—None.

4. Quarantine—None.

5. Concurrent disinfection of articles soiled by discharges from lesions.

6. Terminal disinfection—Thorough cleaning.

(B) General measures—None.

Smallpox.1. *Infectious agent*: Unknown.2. *Source of infection*: Lesions of the skin and mucous membranes of infected persons.3. *Mode of transmission*: By direct personal contact; by articles soiled with discharges from lesions. The virus may be present in all body discharges, including feces and urine. It may be carried by flies.4. *Incubation period*: Ten to fourteen days. (Cases with incubation period of 21 days are reported.)5. *Period of communicability*: From first symptoms to disappearance of all scabs and crusts.6. *Methods of control*:

(A) The infected individual and his environment—

1. Recognition of the disease—(Clinical symptoms. Tests for *immunity* may prove useful.

2. Isolation—Hospital isolation in screened wards, free from vermin, until the period of infectivity is over.

3. Immunization—Vaccination is made compulsory by the Navy Regulations.

4. Quarantine—Segregation of all exposed persons for 21 days from date of last exposure, or until protected by vaccination.

5. Concurrent disinfection of all discharges and articles soiled therewith.

6. Terminal disinfection—Thorough cleaning and disinfection of premises.

(B) General measures—General vaccination in infancy, revaccination of children on entering school, and of entire population when the disease is prevalent. Medical officers must carry out the procedure of vaccination with greatest care.

METHODS OF VACCINATION.

Vaccination should be performed on the outer surface of the upper arm opposite the insertion of the deltoid muscle. The skin at the site of the operation should be cleansed with warm water and alcohol and should be allowed to dry before the vaccine is applied. A drop of vaccine then should be placed on the skin and introduced through the epidermis, but not through the cutis, in one of the following ways, all of which are acceptable. The vaccine should be allowed to dry before the clothing is replaced. A dressing is not necessary.

Incision.—With a point of a needle or scalpel two or three small incisions not more than one-eighth of an inch in length and at least an inch apart are made through the drop of vaccine. The incision or scratch should not be deep enough to draw blood. Cross incisions or multiple incisions must not be employed under any circumstances.

Puncture.—A sterile needle is held nearly parallel with the skin and the point pressed through a drop of virus so as to make about six oblique pricks or shallow punctures through the epidermis to the cutis, but not deep enough to draw blood. The punctures should be confined to an area not more than one-eighth of an inch in diameter.

Chisel method.—The sharp end of a chisel, not more than one-eighth of an inch broad, is held against the tightly stretched skin, and, by a single quick, rotary motion, a small, circular portion of epidermis is removed, exposing the derma and drawing serum, but not blood. The vaccine virus then is placed upon the scarified spot and rubbed in by means of a sterile toothpick. This is the preferable method.

INTERPRETATION OF RESULTS OF VACCINATION.

A proper interpretation of the reaction following vaccination is necessary. Vaccination, properly performed, using fresh, potent virus, will result in one of the following reactions:

Vaccinia or primary reaction.—In a person who has never been vaccinated before, or in those in whom immunity has been lost completely, the take should give the typical picture known as the primary reaction (*vaccinia*). Within from 24 to 36 hours the vaccination wound heals. For the first two days, which is the period of incubation, the site of the little operation remains apparently normal. On the third or fourth day a small papule appears on the skin where the vaccine virus was introduced. In another day a small vesicle appears on the summit of papule. This vesicle gradually increases in size, umbilication developing as it enlarges. The umbilication is due to the multilocular nature of the vesicle; if pricked with a needle, only that portion of the lymph contained in the compartment opened will exude. The vesicle develops into a pustule by the eighth or tenth day, turning yellowish in color, the skin around it becoming more inflamed. In two or three days the pustules dry and a scab is formed, which drops off in 10 days or two weeks, leaving a permanent pitted scar.

Vaccinoid or accelerated reaction.—In persons previously vaccinated, or those having had smallpox, but who partially have lost their immunity, the accelerated reaction is obtained. The accelerated reaction runs a somewhat more rapid course, in which the period of incubation is shortened and in which the height of the pustular stage is reached about the sixth or eighth day. All signs and symptoms are less severe than in the primary reaction. The resulting scar is much smaller and not so deep.

Both of the above reactions should be considered as a *positive take*.

Immediate reaction (reaction of immunity).—Where the immunity of the individual is still present, the immediate reaction will be obtained, which resembles a cutaneous tuberculin reaction. Within 24 to 48 hours after the inoculation a small reddened papule appears, which fades out by the fourth day without producing a vesicle. This reaction is often pronounced and recorded as negative, whereas it is in reality an excellent indication that immunity is still present. It always should be looked for from 36 to 48 hours after inoculation. If the papule is delayed until the fifth day, it is indicative of an abortive reaction and the operation should be repeated with fresh virus.

When none of the above reactions are obtained—primary, 5–9 days; accelerated, 3–5 days; immediate, 24–48 hours—the medical officer should investigate the potency of the virus by vaccinating persons who have never been vaccinated before. The technique of the operation also should be investigated thoroughly.

Vaccine virus is very liable to lose its potency if it is not kept in a cool place, preferably on ice. It should be used immediately after removal from the ice box.

Tetanus.

1. *Infectious agent:* *Bacillus tetani*.
2. *Source of infection:* Animal manure, and soil fertilized with animal manure, and, rarely, the discharges from infected wounds.
3. *Mode of transmission:* Inoculation, or wound infection.
4. *Incubation period:* Six to fourteen days, usually nine.
5. *Period of communicability:* Patient not infectious except in rare instances where wound discharges are infectious.
6. *Methods of control:*

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms; may be confirmed bacteriologically.
2. Isolation—None.
3. Immunization—By antitoxin, single or repeated injection.
4. Quarantine—None.
5. Concurrent disinfection—None.
6. Terminal disinfection—None.

(B) General measures—

1. Supervision of the practice of obstetrics.
2. Educational propaganda such as "safety-first" campaign, and safe and sane Fourth of July" campaign.
3. Prophylactic use of tetanus antitoxin where wounds have been acquired in regions where the soil is known to be heavily contaminated, and in all cases where wounds are ragged or penetrating.
4. Removal of all foreign matter as early as possible from all wounds.
5. Supervision of biological products, especially vaccines and sera.

Trachoma.

1. *Infectious agent:* The chief, although not yet known to be the only, infectious agents are the hæmoglobinophilic bacilli, including the so-called Koch-Weeks bacillus.

2. *Source of infection:* Secretions and purulent discharges from the conjunctivæ and adnexed mucous membranes of the infected persons.

3. *Mode of transmission:* By direct contact with infected persons and indirectly by contact with articles freshly soiled with the infective discharges of such persons.

4. *Incubation period:* Undetermined.

5. *Period of communicability:* During the persistence of lesions of the conjunctivæ and of the adnexed mucous membranes or of discharges from such lesions.

6. *Methods of control:*

(A) The infected individual and his environment—

1. Recognition of the disease—Clinical symptoms. Bacteriological examination of the conjunctival secretions and lesions may be useful.
2. Isolation—Exclusion of the patient from general school classes.
3. Immunization—None.
4. Quarantine—None.

6. *Methods of control*—Continued.

(A) The infected individual and his environment—Continued.

5. Concurrent disinfection of discharges and articles soiled therewith.

6. Terminal disinfection—None.

(B) General measures—

1. Search for cases by examination of school children, of immigrants, and among the families and associates of recognized cases; in addition, search for acute secreting disease of conjunctivae and adnexed mucous membranes, both among school children and in their families, and treatment of such cases until cured.

2. Elimination of common towels and toilet articles from public places.

3. Education in the principles of personal cleanliness and the necessity of avoiding direct or indirect transference of body discharges.

4. Control of public dispensaries where communicable eye diseases are treated.

SUMMARY OF METHODS USED IN THE PREVENTION AND CONTROL OF COMMUNICABLE DISEASE.

1. Public health education.
2. Early detection of cases and prompt isolation.
3. Quarantine.
4. Detection of carriers.
5. Disinfection and extermination of insects.
6. Closure of places of public assembly.
7. Regulation of travel from ship or from shore station to ship.
8. Sanitary regulation of housing conditions; i. e., number of men living in barracks, use of cubicles, proper ventilation, lighting, and heating.
9. Use of masks, goggles, and gowns.
10. Application of disinfectants to mucous membranes of the nose and throat, genital tract, and eye.
11. Internal administration of drugs for prophylactic purposes.
12. Use of vaccine and immune serums.
13. Destruction or control of animals which are actual or potential carriers of disease.
14. Protection against insect carriers of disease.
15. Sanitary control of food supplies.
16. Sanitary disposal of human excreta and refuse.
17. Sanitary maintenance of purity of water supply.

DISINFECTION AND DISINFECTANTS.

Substances used in disinfection are of three classes which are next discussed.

Physical disinfectants.

Sunlight.—Direct sunlight will kill pathogenic bacteria after varying times of exposure. For instance, plague bacilli are killed in less than an hour, while typhoid organisms require six hours' exposure. The violet and ultra-violet rays are the most active, the red and yellow rays being practically inert.

Burning.—Of unquestioned efficiency but seldom practiced on account of expense.

Boiling.—Very efficient and of wide range of applicability. The articles must be wholly immersed for not less than 10 minutes in water actually boiling

(100° C.). The addition of 1 per cent of carbonate of soda renders the process applicable to polished steel, cutting instruments, or tools.

Steam.—(a) Flowing steam (not under pressure) when applied under suitable conditions is an efficient disinfecting agent. The exposure must be continued 30 minutes after the temperature has reached 100° C. (Fig. 139.)

Steam under pressure without vacuum will sterilize, provided the process is continued 20 minutes after the pressure reached 15 pounds per square inch. The air must be expelled from the apparatus at the beginning of the process. If impracticable to obtain the designated pressure, a longer exposure will accomplish the same result.

The best method of applying steam under pressure is in a special apparatus with vacuum attachment, the object of the vacuum apparatus being to expel the

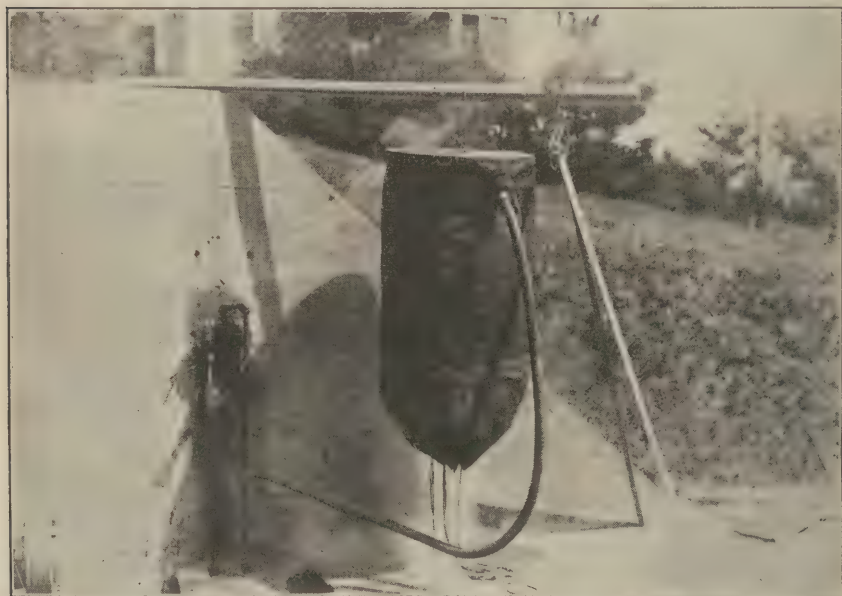


FIG. 139.—Type of sack steam disinfecter operated on a steam line. Note white cloud of steam emerging. For full description see Notes on Preventive Medicine for Medical Officers, United States Navy, United States Naval Medical Bulletin, September, 1922.

air and to promote the penetration of the steam. The process is to be continued for 20 minutes after the pressure reaches 10 pounds to the square inch. A vacuum should be drawn before articles are removed from the sterilizer.

Clothing, fabrics, textiles, curtains, hangings, etc., may be treated by either of the above methods as circumstances may demand.

Articles injured by steam, such as leather, furs, skins, rubber, trunks, valises, hats, and caps, bound books, silks, and fine woolens, should not be disinfected by steam. Such articles should be disinfected by formaldehyde gas or any of the agents mentioned below which may be applicable thereto. Those which will be injured by wetting should be disinfected by a gaseous agent.

Clothing, textiles, and baggage which are clean and in good condition but suspected of infection, can be disinfected efficiently and least injuriously by formaldehyde gas generated by one of the methods described later.

Textiles which are soiled with discharges of the sick or which presumably are deeply infected must be disinfected by one of the following methods:

1. Boiling.
2. Steam.
3. Immersion in one of the germicidal solutions.

Cooking and eating utensils always are to be disinfected by immersion in boiling water or by steam.

Chemical solutions.

Bichloride of mercury.—As a chemical disinfectant corrosive sublimate or bichloride of mercury in solution has been used quite extensively. It has some marked disadvantages, however, which tend to limit its usefulness. It has a destructive action on metals and must be placed in wooden, glass, or earthenware vessels. It can not be used to disinfect any material containing albumin, since it forms inert albuminates. It acts as a mordant and fixes stains in soiled fabrics. It is very poisonous and its solutions should not be used to disinfect dishes to be used later for serving food. Solutions of bichloride of mercury in distilled water after a time become reduced in strength through the formation of oxychloride of mercury, and all are incompatible with alkalies and their carbonates, limewater, soaps, and most metallic salts. As a disinfectant bichloride of mercury commonly is used in a strength of 1-1,000, adding to the water used for solution 2 parts per 1,000 of sodium or ammonium chloride. The material to be disinfected should be immersed in the solution (contained in an earthenware or wooden vessel) for at least an hour. Walls and floors may be scrubbed down with the solution, which should be allowed to dry on them.

Potassium mercuric iodide possesses material advantages as a disinfectant over the bichloride. It is a more powerful germicide, does not coagulate albumin nor cause precipitation with pus or blood unless they are in excess, is more penetrating, less irritating to the skin and to wounds, less toxic, and does not cause immediate corrosion of metals. Potassium mercuric iodide may be prepared by placing 2.9 grams of corrosive mercuric chloride and 8.1 grams of potassium iodide in a mortar and mixing intimately by trituration until the mixture is reduced to a very fine brick-dust powder. This powder should be kept dry in a well-stoppered blue bottle and labeled "Poison." One and one-tenth grams of this mixture equal 1 gram of potassium mercuric iodide. To prepare a 1-2,000 solution of potassium mercuric iodide dissolve 1.1 grams of the potassium mercuric iodide mixture in about 500 c. c. of hot water and dilute to 2,000 c. c.

Carbolic acid (phenol).—The standard solution of carbolic acid is a 5 per cent solution. To make this solution, pure carbolic acid crystals should be melted over a water bath and hot water gradually added. It is an efficient disinfectant and is the standard used for standardizing other disinfectants. Owing to its expense other members of the same group have been introduced for general disinfectant purposes. Among the more efficient and convenient of these is cresol, as Liquor Cresolis Compound, U. S. P. This may be made by mixing 1 part of cresol and 1 part of soft soap and letting stand over night. The resulting compound makes a perfect solution with water, and a 1 in 20 solution is considered equal to a 5 per cent phenol solution. Liquor Cresolis Compound has a disinfectant value of 3 (phenol being 1), lysol 2.12, creolin 3.25, and trikresol 2.62. Faeces, urine, sputum, etc., to be disinfected, should remain in contact with an equal quantity of the cresol compound in 5 per cent solution for an hour. A

5 per cent solution of the cresol compound is suitable for disinfecting spit kids, contaminated clothing, and the walls and decks of compartments. Lysol, creolin, cyllin, izal, and trikresol are other members of this group, but are too expensive for general use.

Formalin.—Formalin containing 40 per cent of formaldehyde may be used in a 5 per cent solution (commercial formalin 50 c. c., water 950 c. c.) as a substitute for bichloride of mercury or carbolic acid, and is useful for the disinfection of surfaces, fabrics, and a great variety of objects, because of its non-injurious character. It is also an excellent deodorant. Formalin to act efficiently must be in at least a 5 per cent solution. For instance, if a pint of fæces is to be disinfected, 1 pint of a 10 per cent formalin solution should be used, the mixture to stand for one hour.

Lime.—It must be remembered that air-slaked lime is inert as a disinfectant. For disinfecting fæces, freshly prepared milk of lime is excellent. It is made by mixing unslaked lime with four times its volume of water. An equal quantity should be added to the fæces to be disinfected.

Chlorinated lime.—When chlorinated lime does not contain less than 30 per cent of available chlorine, it is an excellent disinfectant. When the package containing it is opened there should be a strong odor of chlorine. Its efficacy depends on the chlorine it contains in the form of hypochlorite of lime. For a working disinfectant solution, add 1 pound to 4 gallons of water. This is satisfactory for mopping floors and for disinfecting fæces, sputum, and urine; equal parts of the excreta and disinfecting solution being mixed and allowed to stand for one hour.

For chlorination of drinking water see page 290.

Gaseous disinfectants.

Sulphur dioxide.—This is a weak germicide, but a potent insecticide; to be efficient it requires the presence of moisture. It is only a surface disinfectant and is lacking in penetrating properties. An atmosphere containing 4.5 per cent can be obtained by burning 5 pounds of sulphur per 1,000 cubic feet of space. This amount requires the evaporation or volatilization of about 1 pint of water. Under these conditions the time of exposure should be not less than 24 hours for bacterial infections.

The following standards as to strength and exposure for the destruction of rats and vermin are quoted from the Quarantine Laws and Regulations of the United States.

1. For mosquito destruction: Two pounds of sulphur per thousand cubic feet of space, exposure for one hour.

2. For destruction of lice: Four pounds of sulphur per thousand cubic feet of space, exposure for six hours.

3. For destruction of rats (fleas): Three pounds of sulphur per thousand cubic feet of space, exposure for six hours.

The above standards are for superstructure, partially filled storerooms, and empty holds. For cargo-laden holds and well-filled storerooms, or in compartments that are packed with materials, the time of exposure should be doubled.

The sulphur may be burned in shallow iron pots (Dutch ovens), containing not more than 30 pounds of sulphur to each pot; the pots should stand in vessels of water. Quicker and better results can be obtained from burning the same total amount of sulphur in a number of shallow ovens (Dutch ovens) 5 to 10 pounds in each, than in a few large ovens. The sulphur pots should be elevated from the bottom of the compartment to be disinfected in order to obtain the maximum possible percentage of combustion of sulphur. The sulphur should

be in a state of fine division. Ignition is accomplished best with alcohol (special care being taken with this method to prevent damage to cargo or vessel by fire), or the sulphur may be burned in a special furnace, the sulphur dioxide being distributed by a power fan. This method is peculiarly applicable to cargo vessels. Liquefied sulphur dioxide may be used for disinfection in place of sulphur dioxide generated as above, it being borne in mind that this process will require 2 pounds of the liquefied gas for each pound of sulphur, as indicated in the above paragraph. (Fig. 140.)

Sulphur dioxide is especially applicable to the holds of vessels or to compartments that may be tightly closed and that do not contain objects that would be injured by the gas. Sulphur dioxide bleaches fabrics or materials dyed with vegetable or aniline dyes. It destroys linen or cotton goods by rotting the fiber through the agency of the acids formed. It injures most metals. It is promptly destructive to all forms of animal life. This property renders it a valuable agent for the extermination of rats, insects, and other vermin. Sulphur dioxide is a germicide only in the presence of moisture, and even then will not kill spore-bearing organisms. If clothing is washed immediately after sulphur disinfection, the rotting effect will be greatly lessened. If used in spaces containing machinery, all metal parts should be coated with vaseline.

Formaldehyde.—Formaldehyde is effective as a surface disinfectant if applied by one of the methods given below. Formaldehyde gas has the advantage as a disinfectant that it does not injure fabrics or most colors. It is valueless as an insecticide and fails to kill vermin, such as rats, mice, roaches, bed-bugs, etc. It is not applicable in the disinfection of holds of large vessels. Formaldehyde is used in the disinfection of rooms, clothing, and fabrics, but should not be depended upon for bedding, upholstered furniture, mattresses, and the like, where deep penetration is required. The temperature should be above 50° F., and there should be at least 60 per cent of humidity for efficient formaldehyde disinfection. Many formalin solutions do not contain 40 per cent formaldehyde, owing to evaporation or deterioration, and it is advisable to use a quantity in excess of the amount prescribed in these regulations. It is not efficient in cold dry rooms.

The method of producing formaldehyde gas by pouring formalin on potassium permanganate is one of the most convenient and efficient of the various methods and has replaced largely the more expensive autoclaves and lamps. To prepare a room for disinfection, measure the net cubic space and calculate the amounts of ingredients required. Allow 500 c. c. of formalin and 250 grams of potassium permanganate or 250 grams of barium dioxide for each 1,000 cubic feet of space. Paste up with paper strips all cracks and openings. Then take a pan partly filled with water and place in this a second receptacle of glass or metal containing the permanganate or barium dioxide. Then pour the formalin from a pitcher or bucket on the permanganate crystals or barium dioxide powder. The gas is generated in great amount in a few seconds. The receptacle containing the formalin and permanganate or barium dioxide should be large enough to contain ten times the volume of formalin, as there is a tendency for the mixture to foam over the sides of the container. The room or compartment should be closed tightly for 6 to 12 hours and then flooded with air, and sunshine if possible.

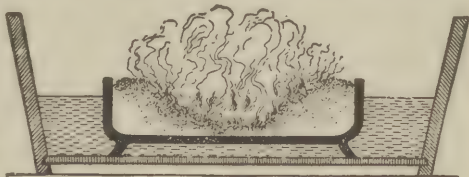


FIG. 140.—Burning sulphur. (Mason.)

Another practical method is that of spraying formalin on sheets. The formalin (40 per cent) should be sprayed on sheets suspended in the room in such a manner that the solution remains in small drops on the sheet. Spray not less than 10 ounces of formalin (40 per cent) for each 1,000 cubic feet. Used in this way a sheet will hold about 5 ounces without dripping or the drops running together. The room must be very tightly sealed in disinfecting with this process and kept closed not less than 12 hours. The method is limited to rooms or compartments not exceeding 2,000 cubic feet. The formalin also may be sprayed upon the walls, floors, and objects in the room.

For single rooms the use of a paraform lamp is quite convenient. Special lamps can be obtained to burn the paraform tablets or a pint tin cup will suffice for the heating of 1 ounce of paraform. The lamp or alcohol flame under the receptacle must not be high enough to ignite the paraform, which burns readily and in so doing does not give off formaldehyde gas. One ounce of paraform is sufficient for a space of 500 cubic feet. One can dissolve 2 ounces of paraform in 8 ounces of boiling water and then pour this over 4 ounces of potassium permanganate in a 2-gallon pail.

Hydrocyanic acid gas.—Hydrocyanic-acid gas is the most penetrating and the most toxic of all fumigants. As an insecticide it is superior to all other gases, but it is not efficient as a germicide. It is generated easily and quickly, requires very little apparatus, is not destructive to inanimate objects, and in the hands of experienced operators and safeguarded by certain precautionary measures its use is not attended by unusual dangers. It will penetrate into the interior of porous bodies such as mattresses, hammocks, and bags in a short time, and in a longer time into closed drawers, trunks, and other containers having pervious joints and cracks. Those engaged in the work must be properly equipped and supervised with reasonable skill and care or fatalities are liable to result.

Hydrocyanic-acid gas is generated by the mixture of water, sulphuric acid, and a cyanide salt (either potassium or sodium) in the following proportions:

1. To each ounce of potassium cyanide, 1 fluid ounce of commercial sulphuric acid 66 B (degrees Baumé) and $2\frac{1}{2}$ fluid ounces of water shall be used. (Commercial cyanide of potash not infrequently has a fused chloride blended with it. Such preparations should not be used, as the chloride affects the generation of the gas.)

2. To each ounce of sodium cyanide, $1\frac{1}{2}$ ounces of commercial sulphuric acid 66 B and 2 fluid ounces of water shall be used. All ingredients should be weighed and mixed immediately prior to fumigation.

The strength of cyanide gas and the duration of exposure varies with the object sought. The standards in this respect are as follows:

1. For destruction of mosquitoes: One-half ounce of sodium cyanide per thousand cubic feet of space, exposure one-half hour.

2. For destruction of fleas: Two and one-half ounces of sodium cyanide per thousand cubic feet of space, exposure one-half hour. This is of academic interest only, as in practice ships are not fumigated for flea destruction only, but always with the idea of rat destruction as well as flea destruction.

3. For destruction of rodents (rats and mice): Five ounces of sodium cyanide per thousand cubic feet of space, exposure for two hours.

4. For destruction of lice: Ten ounces of sodium cyanide per thousand cubic feet of space, exposure for two hours.

5. For destruction of bedbugs: Five ounces of sodium cyanide per thousand cubic feet of space, exposure for one hour.

The above standards apply to empty holds and superstructures, except storerooms that contain a large quantity of stores. In cargo-laden holds or in well-packed storerooms the length of exposure should be doubled.

The process of fumigation is essentially very simple. The proper quantity of sodium or potassium cyanide (preferably contained in a paper bag) is dropped into a wooden barrel (preferably of oak), an earthenware crock, or an iron bucket (without soldered seams), containing a mixture of sulphuric acid and water in the proper proportions. The operator should leave the compartment as rapidly as possible, tightly closing the entrance to the compartment as he leaves. The gas should be allowed to act for from 1 to 48 hours according to the circumstances. When the compartment is opened it should be thoroughly ventilated before a human being is permitted to enter. A captive animal, such as a guinea pig, rat, or cat, should be lowered or put into the compartment for a few minutes to determine whether it is safe for a person to enter.

On account of the great danger to human life from hydrocyanic acid gas the entire crew should be removed from the ship during the fumigation process and none should be permitted on board until the medical officer having charge of the fumigation operations states that it is safe.

General instructions for fumigation of vessels.

For computing the air space of a vessel a registered ton should be estimated as containing 100 cubic feet. A vessel of 1,000 net tonnage would, therefore, contain 100,000 cubic feet of air space in the holds alone, since net tonnage indicates the cargo carrying capacity in contradistinction to the gross tonnage which indicates the ship's total cubic capacity. The cubic capacity of crews' quarters, cabins, engine room, poop deck, or other above-deck compartments have to be computed for each individual compartment.

The various details in connection with the fumigation of vessels are of an importance almost equal to the nature of the fumigant used, and the observation of these details to a large extent determine the effectiveness or the inefficiency of the fumigation. All possible care should be observed to see that dead space in the vessel is opened up and all practical measures should be taken to aid in the diffusion of the fumigating gas; this is especially important when sulphur dioxide is used. All dunnage and loose material from the holds of a vessel that is not cargo-laden should be arranged in compact order and placed on elevated platforms to avoid rat harborage. If sulphur dioxide is generated in a furnace and led into the vessel, it should be introduced at the lowest point and the hatches left open for a short while so as to permit of the escape of air and hasten diffusion of the sulphur fumes. Pipe casing should be opened up and from one end of the vessel to the other there should be a certain number of limber boards removed so as to permit of penetration of the gas into the bilges. Any planked-over spaces between the outer and the inner sheathing of a vessel also should be opened freely, and whenever there is dead space, it should be opened up so that there will be free circulation of the gas. Careful attention should be given to lifeboats, which often are infested by rats which resort to these places for water. Preferably, lifeboats should be cleaned and flooded by water prior to fumigation of the vessel. Very close attention should be given to the poop deck, which is a space frequently containing a heterogeneous collection of litter and is generally badly rat infested. In general, the engine room and firerooms do not harbor rats, but in the treatment of a plague-infested vessel they should be fumigated.

The cost of the disinfectants for naval vessels as well as their fumigation is a charge against appropriations of the Bureau of Construction and Repair and not against those of the Bureau of Medicine and Surgery.

Preparation of spaces to be disinfected.

The disinfection of a room requires careful attention to detail on the part of those doing the work. The room should be sealed as nearly hermetically as possible. The cracks around the doors, transoms, windows, fireplaces, entrances of radiator pipes, and heating and ventilating openings should be made air-tight by pasting paper over them. (Fig. 141.) For the closure of cracks in the doors, windows, and the like, the following has been found to be a useful method: Cut strips of newspaper sufficiently wide, say 3 inches, smear green soap over them and then paste over the cracks. This will be found to be air-tight and has the advantage of dissolving readily with water when it is desired to remove the paper after disinfection. Starch paste, flour paste, and the like may be used,



FIG. 141.—For the purpose of fumigation, all cracks around doors and windows except the door of exit should be sealed with adhesive paper. (Boyd.)

but green soap is preferable when available. The keyhole, voice tubes, and the cracks at the meeting rail of upper and lower window sashes should not be forgotten. Material and utensils should be in readiness to seal the door of exit after the operator has started the generation of the disinfectant, and hurriedly left the room.

On board ship the fumigation of certain compartments is comparatively easy, and in other cases extremely difficult. The presence of water-tight doors and air-ports, each of which has its rubber gasket, enables the closure of these openings without pasting paper over them. The ventilating louvers must be tightly closed by sealing them up, and care must be taken to see that the small triangular openings which result from the overlapping of steel plates at their point of contact with a bulkhead are also closed. In staterooms the grating at the top for purposes of ventilation should be closed. Any metal in the room, especially brass, should be coated with vase-

line if sulphur dioxide is to be used. Drawers should be opened and their contents shaken out or strung on lines in the room. Bedding should be treated similarly to enable the gas to come in contact with all surfaces to be disinfected, since the gaseous disinfectants possess little or no penetrating power.

In large compartments on the gun deck there may be great difficulty in closing sufficiently to perform a fumigation. In such case thorough aëration and the use of disinfecting solutions will accomplish the desired effect. If the fumigation of a ship is intended to be general, preparation should be made to commence the generation of the fumigant almost simultaneously in the various parts of the ship. It is desirable to commence at one end of the ship, disinfecting one compartment after another and driving rodents and vermin ahead of the disinfecting process toward the other end of the ship. Employment of this

method is more apt to result in exterminating vermin than if isolated compartments are fumigated from time to time, the vermin being driven from a compartment, seeking refuge in an adjacent one, and returning to infest the fumigated one after the process is repeated.

Destruction of vermin.

The following agents are useful for the destruction of vermin:

(a) *Hydrocyanic acid gas.* (See p. 270.)

(b) *Sulphur dioxide.* (See p. 268.)

(c) *Steam.* (See p. 266.)

(d) *Oxide of carbon.*—The oxides of carbon are efficient to destroy rats, but do not kill fleas or other insects. They are obtained by burning carbon, coke, or charcoal in special apparatus. The gas as produced consists of about 5 per cent carbon monoxide, 18 per cent carbon dioxide, and 77 per cent nitrogen. Twenty kilos of carbon, coke, or charcoal are used for every 1,000 cubic meters of space. The gas is allowed to remain in the ship for two hours, and from seven to eight hours are allowed for it to leave. This is about equivalent to $1\frac{1}{2}$ pounds of carbon (coke) to 1,000 cubic feet of air space. As this gas is very fatal to man and gives no warning of its presence, being odorless, a small amount of sulphur dioxide should be added to give warning of its presence. As it does not kill fleas, it can not be depended on for complete work, where there is evidence of plague among rats on the vessel, as the infected fleas would infest the rats coming aboard after the deratization.

(e) *Pyrethrum.*—The fumes of burning pyrethrum may be used to destroy mosquitoes when other fumigants are not available or when they can not be used. Four pounds per 1,000 cubic feet of space with two hours' exposure will destroy practically all mosquitoes, but precautions should be taken to sweep up and destroy any that may have escaped. Pyrethrum stains walls and paper, and is the least reliable of the culecides.

Rats.—Where it is impracticable to exterminate rats by the use of hydrocyanic acid gas, funnel gases (carbon monoxide and carbon dioxide principally) or sulphur dioxide, an endeavor should be made to eliminate them by: (1) Trapping, using a suitable bait, such as cheese, skin of a ham, grain, or other food which is not easily obtained by rats. Traps should be placed in rat runways or near rat holes and always should be placed out of sight. Snap traps are more efficient than cage traps. (2) Poisoning—Arsenic in the strength of 25 to 50 per cent by weight, combined with corn-meal mush or cooked rice, to which a little sugar or syrup may be added, has proven to be very effective. (*Poison should not be used when other animals or humans are liable to mistake it for food.*) A mixture composed of plaster of Paris 6 parts, pulverized sugar 1 part, and flour 2 parts has been used to advantage in the destruction of rats. This should be exposed in a dry place in open dishes. To attract rats the edge of the dish may be smeared with oil in which sardines have been packed. (3) Starvation. Food should be kept in rat-proof containers and garbage in rat-proof metal garbage cans. (4) Rat proofing of houses. (5) Placing rat guards on all ship's lines.

Fleas.—Fleas may be destroyed by: (1) Hydrocyanic acid gas; (2) sulphur dioxide; (3) crude petroleum (fuel oil), kerosene oil, or gasoline; (4) an emulsion of kerosene oil made as follows: Kerosene 20 parts, soft soap 1 part, water 5 parts (the soap is dissolved in the water by aid of heat and the kerosene oil gradually stirred in the hot mixture).

Lice.—Lice may be destroyed by: (1) Dry heat at 60° C., exposure 30 minutes. (2) Hot water 60° C., exposure 30 minutes. (3) Steam under pres-

sure, exposure 15 minutes. Vacuum should be obtained both before and after placing clothes in sterilizer in order that they may be dry when removed. (Articles such as leather, furs, skin, rubber, books, etc., should not be placed in the sterilizer.) (4) Steeping for 20 minutes in a 2 per cent solution of equal parts of crude carbolic acid and soft soap in water at a temperature not below 50° F. (5) Immersion of verminous garments in gasoline, benzine, kerosene, turpentine, dichlorethylene (Dutch liquid, Dutch oil), or tetrachlorethane (carbon bichloride). (The latter two are not inflammable.)

In addition to the treatment of the clothing of infested persons it is well to wash the body with liquid soap, made by boiling soap chips, 1 part, in 4 parts water, and adding kerosene 2 parts. After this mixture jellies, use by mixing 1 part with 4 parts of warm water.

In the case of a male person infested with *pediculus capitis*, the hair should be clipped short. In the case of a female, the hair should be treated by a thorough application of a mixture of equal parts of kerosene oil and vinegar. The head then should be covered with a towel and, after a lapse of a half hour, washed with warm water and soap. The kerosene kills the lice and the vinegar loosens the nits.

Pediculi pubis should be destroyed by clipping the pubic hairs and by application of mercurial ointment (50 per cent) or kerosene oil.

Cockroaches may be eliminated by: (1) Hydrocyanic acid gas. (2) Sulphur dioxide. (3) Steam (4) Sodium fluoride powder, which must be liberally sprinkled or blown by means of a powder blower into corners, drawers, closets, and other places of concealment. It must be distributed in such a way that it will not be swept up or removed. It should be allowed to remain and act for weeks at a time. (5) Trapping: A simple form of trap consists of a dish, basin, or jar with a stick leading up to the top as a runway from which they slip into the trap which has been baited with mucilage or sweetened meal. (6) Mixture of kerosene 98 per cent and cresol 2 per cent, which should be sprayed into infested places.

Bedbugs may be eliminated by: (1) Hydrocyanic acid gas. (2) Sulphur dioxide. (3) Steam under pressure in a special apparatus with vacuum attachment is the simplest way of ridding mattresses and bedding of bedbugs. (4) Heated air. It has been found that a temperature of 140° F. is sufficient to kill bedbugs and their eggs. (5) Kerosene and cresol solution (2½ per cent in water), equal parts, when properly applied. (6) Turpentine and phenol (95 per cent solution in water), equal parts, when applied with paint or varnish brush. (7) Flaming: Useful for metal beds and springs. (8) Oil of mirbane three-fourths ounce, crystallized carbolic acid 1½ ounces, kerosene or benzine 32 ounces. Add the oil of mirbane to the kerosene; stirring slowly. The carbolic-acid crystals, after having been liquefied, should be added to the mixed oil, stirring rapidly. (9) Sodium chloride (common salt) one-half ounce, bichloride of mercury (corrosive sublimate) one-half ounce, water 2 ounces, alcohol 2 ounces, spirits of turpentine 6 ounces.

The above mixtures may be applied with feathers, small brushes, or spray syringes.

MARITIME QUARANTINE.

Medical officers of ships acting as health officers of the population under their charge are required to comply with the quarantine laws of this and other countries, and also naval medical officers from time to time are required to act as health officers of the port in certain of our colonial possessions.

Ships arriving in the United States with any of the following diseases on board are quarantinable, viz., leprosy, cholera, plague, smallpox, yellow fever, and typhus fever.

Alien lepers are not permitted to land. Lepers, if citizens of the United States, must be handled in accordance with the local laws in force at the port of landing.

Persons exposed to any of the following diseases should be quarantined for the full period of incubation, viz., cholera, 5 days; yellow fever, 6 days; smallpox, 18 days; typhus fever, 12 days; plague, 7 days.

The certificate of a naval medical officer concerning the sanitary conditions prevalent on his ship usually is accepted by the health authorities of the port.

AIR, VENTILATION, HEAT, AND HOUSING.

Air constitutes a gaseous ocean in which we live; it is made of a mixture of gases and is not a chemical compound. The percentage of ingredients of this mixture by volume are approximately as follows: Oxygen, 21; nitrogen, 78; carbon dioxide, 0.03; argon, 0.94; and traces of such gases as helium, krypton, neon, xenon, hydrogen, hydrogen peroxide, ammonia, and ozone. In addition to the above there is present in the air varying amounts of water vapor, and there are suspended in the air such particles as dust, bacteria, yeasts, etc.

Air and its relation to health.—Air in relation to health serves two important functions, the interchange of gases in respiration and the regulation of body temperature. For the part which air plays in our body economy through respiration, see aëration of the blood in the chapter on Anatomy and Physiology. As described in the chapter on Food and Dietetics, this process of metabolism, which is coexistent with life, results in the creation of tremendous amounts of heat by our bodies. If there were no means by which this heat could be eliminated death soon would result. The means by which the heat manufactured by our bodies is eliminated is mainly through the air by radiation, conduction, convection, and evaporation (perspiration), which will be described in detail later.

The name "crowd poisoning" is applied to the symptoms arising in individuals when confined in poorly ventilated halls, compartments, and rooms, or those symptoms arising in men marching in the center of military formation on warm, humid days. Crowd poisoning may be acute or chronic. Acute crowd poisoning is closely related to heat stroke and heat exhaustion. (See chapter on First Aid and Minor Surgery.) The acute effects of vitiated air usually are lassitude, headache, dizziness, nausea, vomiting, and even collapse; in extreme cases, death may ensue. The chronic effects, so far as known, include anemia, weakness, and disturbances of digestion. Prolonged exposure to vitiated atmosphere influences all our life functions and lowers our resistance to certain infections, e. g., the pus cocci, the tubercle bacillus, the pneumococcus, and the microorganisms causing common colds (see lowered resistance in section on Immunity). When a group of individuals occupy a relatively small, poorly ventilated space, there is only a comparatively small decrease of oxygen and increase of carbon dioxide before symptoms of crowd poisoning appear. It will be shown later that an atmosphere with an oxygen content of only 15 per cent, and a carbon dioxide content of 2 to 4 per cent may not be harmful. It has been shown that rebreathing of air causes the air to become more and more humid, and, of course, the evaporation from our body surfaces causes the same thing. Moreover, the humidity of inhabited rooms becomes higher and higher. In other words, there is marked change in the physical

conditions of the air. It can be shown that in a room where individuals are suffering from "crowd poisoning," by lowering the temperature, decreasing the humidity, or setting up air currents, the symptoms of crowd poisoning can be made to disappear, showing that it is a change in the physical condition of the air which is the most important factor in crowd poisoning, and not, as formerly thought, a change in the chemical constituents.

Chemical constituents of the air and their relation to health.—Oxygen affects the combustion of the food eaten and stimulates digestion and metabolism. (See chapter on Anatomy and Physiology.) Nitrogen simply acts as a diluent for the oxygen and plays no active part in our body economy. Small variations in the oxygen content of the air make no special difference in our body functions; it may drop to 17 per cent or may rise to 25 per cent or higher, without any apparent alteration in our body functions. An atmosphere, however, containing only 11 to 12 per cent of oxygen becomes dangerous, and 7.2 per cent results in death. Localities where the air is liable not to contain a sufficient percentage of oxygen to support life are the bottoms of deep wells, in submarines, and in the double bottoms of ships, especially when these latter have been sealed for a long time, and such substances as red lead and linseed oil have consumed a considerable portion of the oxygen of the air. Before entering a deep well, or double bottom, the air should be tested to determine whether it is low in oxygen.

The normal variations of the carbon dioxide of the air are too small to be of sanitary importance, and it is only when stagnant or enclosed air has its carbon dioxide content very much increased that it may have a bearing on health. Carbon dioxide is not a poison. A certain amount of carbon dioxide is necessary for the body, as by its presence in the blood, the action of the heart is regulated and the respiratory center stimulated. With any great increase in carbon dioxide content, for instance up to 5 to 15 per cent, there is generally a corresponding decrease in the oxygen content. The carbon dioxide content of air, however, is an indication of the amount of use of certain air by human beings, and its estimation may be used as the index of vitiation, but this is not as reliable as was once thought.

The other chemical constituents of the air, with the exception of nitrogen, which is discussed under the heading "Effects of Increased and Decreased Atmospheric Pressure," have so little bearing on health it is not considered necessary to discuss them.

Physical properties of the atmosphere and their relations to health.—By the physical properties of the air is meant the temperature, the humidity, and the movement of air. Their relation to our body health depends on how much or how little they affect the dissipation of heat from our body surfaces by radiation, conduction, convection, and evaporation.

By *radiation* is meant the emanation of heat rays in direct lines from an object generating heat, e. g., the heat of a fire felt when standing in front of it. By *conduction* is meant transmission of heat to a contiguous substance, e. g., when a red-hot poker is put into water, the poker is cooled and the water heated. By *convection* is meant the transmission of heat to a constantly changing medium such as an air current. Heat is lost by *evaporation* in accordance with a law of physics, i. e., when a liquid is changed to a gas, heat is abstracted from the evaporating surface to be stored in the gas as latent heat. If the air has the same or a higher temperature than our bodies, there can be no giving off of heat from our bodies by radiation or conduction; if there is no movement of air about our bodies, there can be no loss of heat by convection; and if the air surrounding our bodies is saturated

with aqueous vapor, there can be no loss of heat by evaporation of perspiration. The above factors explain the discomfort of a hot, still, moist day, and the relative comfort of a hotter day, that is breezy and dry. Where the elimination of heat by our bodies is required, the body, through its heat-regulating center in the medulla, diverts the greater portion of the blood to the skin, thus bringing it in contact with the air and permitting the elimination of heat by radiation, conduction, and convection, and also causes perspiration to be increased, thus permitting elimination of heat by evaporation. When conservation of heat is required by the body, through the same heat-regulating center, the amount of perspiration is diminished, and the blood diverted to the interior of the body.

If these physical properties of the air are such that not enough of our body heat can be thrown off, symptoms such as heat stroke, heat exhaustion (see chapter on First Aid and Minor Surgery) and "crowd poisoning" result.

On the other hand, if the physical properties of the air surrounding the bodies are such that too much heat is eliminated, general or local freezing may result (see chapter on First Aid and Minor Surgery) or there may be a lowering of resistance to such diseases as pneumonia, colds, etc. Humidity influences the output of heat from the body in two ways: (1) It increases the conductivity of atmosphere for heat—a cooling influence—hence cold moist air is chilling; (2) it interferes with evaporation of perspiration—a heating influence—hence warm moist air is enervating. There is a neutral zone, around 68° F., at which humidity has comparatively little effect. Hence, if the temperature of a room is kept just right and the occupants are sitting still, it makes little difference whether the air is humid or dry. However, a difference of a few degrees above or below this temperature will have a marked influence. If air is too dry, as a general rule it results in parched and irritated mucous membranes of the mouth and nose and smarting of the eyes from too rapid evaporation. The so-called comfort zone has a maximum temperature 70° F., a minimum humidity, 30 per cent; a minimum temperature, 55° to 60° F., and a maximum humidity, 55 per cent. The body has, however, great powers of adaptability by a gradual change, and this is one of the factors in acclimatization.

The effects of increased atmospheric pressure upon health.—Whether we live at sea level or on mountain tops, the pressure of gases in our tissues is in equilibrium with the pressure of gases surrounding us. With sudden changes of atmospheric pressure, certain changes and symptoms are produced in our bodies by the effort on the part of the gases, principally nitrogen, within our bodies, to come into equilibrium with the atmospheric pressure outside, and also by the fact that the atmospheric content of oxygen per cubic foot decreases with the pressure, and vice versa.

Men in the Navy are subjected to increased pressure principally in deep-sea diving. With every 10 meters' depth in diving the pressure increases 1 atmosphere—e. g., at a depth of 30 meters (about 100 feet) a diver is exposed to a pressure of 4 atmospheres, or about 60 pounds to the square inch. The symptoms produced as pressure is being increased are not particularly marked; there is a slowing of respiration, and pain in the ears due to pressure on the ear drums, which may be relieved by swallowing. It is when the diver is brought to the surface from under pressure that dangerous symptoms may occur; these symptoms are spoken of as *caisson disease*. During compression, the body continues to absorb the gases of the air according to physical laws, and as the pressure is released these gases are released in accordance with the same laws. If the decompression is too rapid, the molecules of gases within

the body tissues and fluids tend to coalesce and form bubbles, and the escaping of these bubbles through the tissues, and particularly through the capillary walls, causes the symptoms of caisson disease. The symptoms of caisson disease are excruciating pain in the muscles and joints, called "bends"; hemorrhages from nose and ears; paralysis, unconsciousness, and even death from plugging of blood capillaries by air bubbles (air emboli) and hemorrhages into the brain and spinal cord. The prevention of caisson disease consists in decompressing individuals subjected to high pressures gradually; this may be accomplished by putting them through graduated decompression chambers, or in the case of divers by raising them to the surface slowly. If a man begins to show symptoms of caisson disease, he must be placed immediately under pressure and decompressed slowly.

The effects of decreased atmospheric pressure upon health.—The symptoms of decreased pressure are due to the rarefied air, as well as to the decreased pressure, and come on when ascending high mountains or ascending in aircraft. The limit at which life may be sustained is about 26,000 feet, at which height consciousness is lost. The symptoms commonly are spoken of as "mountain sickness." The effects of decreased pressures are increased by cold, active muscular exertion, or improper clothing. The noticeable symptoms are increase in the respiration; noises in the head and dizziness; impairment of the senses of sight, hearing, and touch; dullness of the intellectual faculties, and a strong desire to sleep. With more sudden changes to a rarefied atmosphere, fainting, weakness, difficult breathing, dizziness, nausea, and vomiting may occur. The prevention of mountain sickness consists in keeping warm, avoidance of muscular exertion, inhalations from an oxygen tank, and *gradual* ascent into rarefied atmosphere.

Poisonous gases which may contaminate the air of naval ships.—The commonest poisonous gas found at times in the air is carbon monoxide, which has been considered in the section on suffocation in the chapter on "First Aid and Minor Surgery." Such gases as chlorine, resulting from sea water getting around storage batteries, methane from coal bunkers, etc., may contaminate the air of naval ships and produce characteristic poisoning. Sewer gas and other noxious odors do harm by affecting our mental state, but other than that are not particularly harmful.

Microorganisms in the atmosphere.—In the open air, on account of nature's disinfecting agencies, there is very little danger from pathogenic microorganisms, except in the immediate neighborhood of persons with diseases spread by mouth, nose, and throat secretions, but in crowded, ill-ventilated halls and compartments there is considerable danger of this because of the constant spraying of the air by coughing, sneezing, etc., on the part of the inmates, because of the sweeping of the decks or floors, where the inmates may have expectorated, and because nature's disinfecting agencies are not as powerful under these conditions.

Ventilation.

Ventilation is the process by which air, the physical and chemical compositions of which have been vitiated by human use, is removed and replaced with fresh air, having the proper physical and chemical conditions for the use of our bodies.

Before discussing ventilation, it will be well to see what is meant by good air, bad air, and the changes which take place in normal atmosphere when human beings occupy a confined space.

By good air is meant air which is free from dust, smoke, and odors, of moderate coolness and humidity, and free from accumulations of respiratory products and body excretions.

By bad air is meant air which produces discomfort which is caused by heat and humidity and the odors of the air in closed spaces. Whereas the odors are of no definite harm to the body, except for being disagreeable, it is one of the best indicators of poor ventilation, since well-ventilated rooms are usually free of odors.

The following changes take place in normal atmosphere when human beings occupy confined spaces:

(1) The oxygen is reduced by respiration.

(2) The carbon dioxide is increased by the same process.

(3) There is given off in the air a greater or lesser amount of organic matter, which is perceived by us as odors. Most of this organic matter comes from the mouth, from the teeth, skin, and clothing, and, to a lesser extent, from the lungs.

(4) The temperature of the air is raised by the heat given off by the body in the process of metabolism.

(5) The humidity of the air is increased by the moisture given off from the breath and from the skin of the body.

(6) Bacteria are supplied by the body.

(7) Dust is stirred up as a result of the movements of the body.

Ventilation is designated as natural and artificial. Inasmuch as the Navy has to deal with ventilation afloat and ashore, each will be taken up separately.

Ventilation of houses.—*Natural ventilation ashore* is produced by having openings in the walls, floors, and ceilings of a room, which permit of free natural circulation of the outside air. This can be obtained best by having openings on opposite sides of the room. Natural ventilation may be assisted ashore by window ventilators, ridge ventilators, screens over windows, etc.

Artificial ventilation on shore is much the same as that used aboard ship. It is produced by fans, blowers, or other mechanical appliances, all of which will be described under "Artificial ventilation of ships."

Ventilation of ships.—On ships *natural ventilation* occurs (1) through permanent openings in the decks or hull, such as hatches or openings in the deck for access to spaces below; (2) ventilating cowls; (3) air ports in the ship's sides; (4) smoke pipes and smoke-pipe casings; (5) elevator shafts; (6) chutes; (7) voice tubes; (8) cargo ports; (9) ammunition hoists; and (10) gun ports. Natural ventilation may be assisted by the use of scoops in air ports, wind sails, and screens.

In the *artificial ventilation of ships* there are three systems which may be used: (1) The plenum, or supply system; (2) the exhaust system; (3) a combination of the plenum and exhaust system.

The *plenum or supply system* is that in which fresh air is drawn from without and supplied by means of centrifugal or propeller fans to the spaces to be ventilated. For systems of duct ventilation, such as is used aboard ship, the centrifugal type of blower fan is used. The fresh air is drawn in by a central opening at the side and forced out by the revolutions of the blades through a duct at the left which is connected to a series of ventilating ducts which distribute the air to the compartment. It is important, in planning for plenum ventilation, either ashore or afloat, that the air should be taken in at such a point as to be protected from sources of odors and dust. Plenum ventilation often is combined with air washing or artificial humidification as well as with heat.

When the centrifugal type of fan is used for an exhaust system, the ducts leading from the compartment must be connected with the central opening and the other opening of the fan with the outside air.

The terminals of the various distributing ventilating ducts vary in location. The terminals in the plenum system of ventilation should be located as nearly as possible in the breathing zone, yet they should be placed so that they do not produce drafts uncomfortable to the occupants. In our latest type of ships the terminals of the air ducts are placed at a level of about 3 feet above the deck, and the air current is directed horizontally to avoid raising dust from the deck.

The *exhaust system* is the reverse of the plenum system. Instead of supplying fresh air and allowing it to escape through natural openings, the exhaust system draws the vitiated air from the compartment, discharges it to the outer air, and makes no provision for the admission of the fresh air, except as it may come in through natural openings, such as hatches, etc., to take the place of the withdrawn foul air. This system possesses disadvantages, and should be employed alone only in places where great heat, humidity, injurious gas, and dust, or disagreeable odors should be removed. It generally is used in "heads" and magazines.

The *combined system* of ventilation provides for a plenum system and an exhaust system. Usually this system of ventilation is used in sick bays.

In any system of ventilation an endeavor should be made to supply each occupant with 3,000 cubic feet of fresh air per hour. A properly designed system will allow six complete changes of the air during this time.

The efficiency of ventilation may be tested in the following manner:

(1) By making an analysis of the various portions of the air of the compartment when occupied. This analysis may be divided into four parts:

(a) Estimation of carbon dioxide content.

(b) The physical examination, which consists in noting any odors or excessive dust which may be present; and the determination of the temperature by a wet and dry bulb thermometer (psychrometer) (Fig. 142), in this way determining the temperature and humidity.

(c) The determination of the movement of the air.

(d) The determination of the cooling power of the air.

(2) Clinical effects—that is, the effect on the occupants living in the compartment.

Heating.

There are three methods in common use for heating compartments or rooms—(1) direct heating, effected by radiators, open fires, stoves, open gas heaters, etc.; (2) indirect heating, effected by supplying to the room air previously heated elsewhere, as by furnaces or by a thermoventilation system; (3) direct-indirect heating, effected by a combination of the two methods described above, in which part of the heat is supplied by warm air entering the room and part by local radiators or stoves.

Most of our barrack buildings on shore, and the older ships of the Navy, as well as the modern smaller ships, are heated by the direct method, but all of our modern capital ships are heated by the indirect system, or by the direct-indirect system combined. In the indirect systems, such as used aboard ships of the *Tennessee* class, the air also is humidified. This system of heating is difficult to control.

Regardless of what heating system is used, living rooms ashore and compartments aboard ship should be kept at a temperature of about 65° to 70° F.

Housing of naval personnel.

Overcrowding.—Buildings used as barracks, and compartments aboard ship for sleeping purposes, show great variety in size and type.

The housing of a number of men together in a single room or compartment is always conducive to the spread of disease, especially communicable diseases of the respiratory type and those carried by vermin. Other things being equal, the greater the number of men quartered in a barrack room the greater the danger.

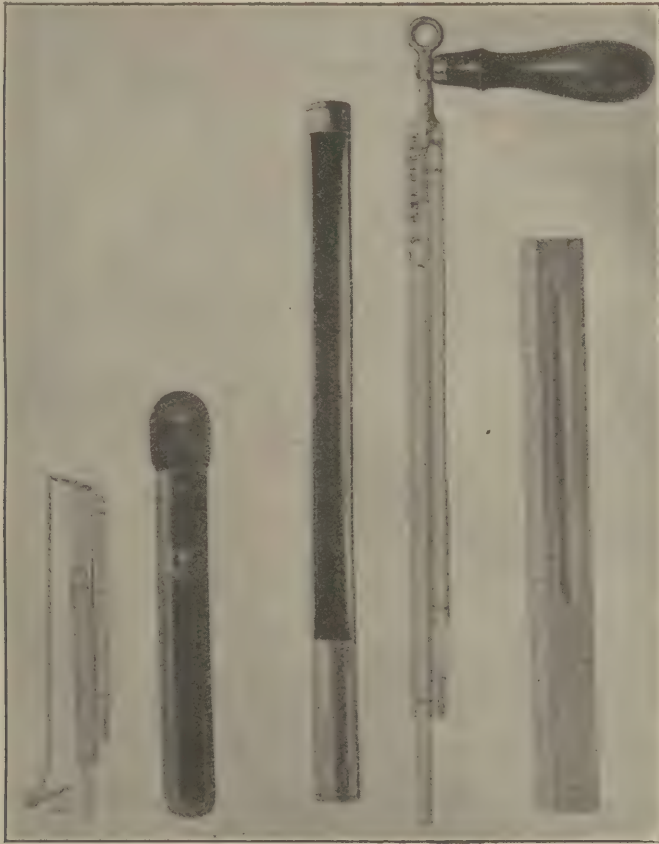


FIG. 142.—Types of sling psychrometers for determining temperature and relative humidity. (Park.)

Under the close associations of barrack life, or life aboard ship, the types of bacteria found in the nose and throat tend to become uniform throughout the personnel. Thus the percentage of those who will become carriers of such pathogenic microorganisms as pneumococci, streptococci, meningococci, and diphtheria bacilli, if the causative agent is introduced, will be much greater than among the same number of persons housed under ordinary conditions. The general principle, therefore, is that small barracks, preferably small individual buildings, or units, are safer than large barracks. Large barracks at least should be divided into compartments to house its occupants more or less separately in groups as small as consistent with military and administrative requirements.

The congestion of population (density) which results from housing a large number of men in barracks, either in a large barracks building or in a number of smaller barracks, is of great epidemiological importance apart from the question of overcrowding. However, other things being equal, the smaller the buildings and the fewer men quartered in each compartment the better.

No barrack room should be planned to accommodate more than 50 men, and under no circumstances should more men be put into a barrack room than the number for which it was planned.

Housing standards for barracks.—Minimum standards with regard to space provide 500 cubic feet of air space and 50 square feet of floor area per occupant. In addition there is a third requirement to fix the other two, namely, that there shall be not less than 5 feet of separation between the center lines of cots, bunks, or hammocks. Without the latter, in wide rooms there could be 50 feet of floor space per person with the cots touching each other. In lofty rooms or compartments there could be 500 cubic feet of air space per capita with much less than 50 square feet of floor area, but this would meet neither simple hygienic nor special epidemiological needs. Even where the required per capita floor space is provided, good administration is necessary with constant watchfulness to see that those in charge of the barracks or the men themselves do not move bunks or cots closer together to make room for other purposes. If space for recreation or other purposes is contemplated for the dormitory compartment, it should be provided wholly in addition to the space provided by the above minimum standards.

Living conditions on board ship.—At first glance it would seem that with a large number of men living together in such a small space as the various decks of a ship together afford, the dangers of overcrowding and density of population would produce their maximum effect. As a matter of fact, it has been our experience that neither density of complement nor overcrowding on board ship is nearly as serious in its results as in barracks ashore. This may be accounted for in several ways.

In the first place, the crew naturally divides into several groups—deck force, subdivided into divisions; engineer force, fireroom force, commissary force, electricians and other artisan groups, mess attendants, etc.—and there is not as much contact between the different groups as one might think; at least, not under conditions which are essentially indoor conditions.

In the second place, the crew of a naval vessel is well disciplined; every man has his station and duties definitely assigned and knows his environment thoroughly.

In the next place, disease is almost bound to be detected early. Every man is under constant watch, and if a man who feels sick or appears ill does not report promptly at the sick bay some one else usually sends him there.

Another important matter is that exposure to foci of infection in civilian communities is inconstant or irregular.

Finally, air passes through a modern ship rapidly, especially in spaces where members of the crew congregate in numbers.

Light and illumination.

Light and its relation to health.—Light may be natural light from the sun's rays, or it may be artificial. The latter is for purposes of illumination and the former serves two purposes, viz., illumination and the production of certain effects on life processes.

Natural light is made up of energy given off from the sun and is conceived of as being made up of waves in the ether of various lengths, the longer color waves when striking our retinas giving us the sensation of red, and the

shortest color waves giving us the sensation of violet, with the intermediate waves giving us the other colors of the spectrum, and the sum total of these waves giving us white light. In addition to the sun's energy, which shows itself in ether waves producing effects in our retinas as colored or white light, there are mingled with these ether waves those which produce heat, the actinic or ultra-violet rays, which are the bactericidal waves of sunlight, and, no doubt, numerous others which are not yet known to human science. Sunlight is absolutely necessary for the growth of most forms of vegetable life, and its effect on the human body is seen in various ways, e. g., children deprived of sunlight are particularly prone to rickets; the stimulating effect of sunlight on going to the Tropics from a temperate climate, followed soon by a depressant one; the production of sunburn and freckles on the human skin. The study of the effects of sunlight on the human body is still in its infancy.

The sanitary factors involved in illumination consist of, first, the effects of different types of illumination on our mental state, and, second, the tendency of various features in illumination to produce eyestrain. Brilliant illumination tends to cheerfulness and activity, and vice versa. Red illumination is stimulating, violet and blue illumination is depressing, and green restful.

Eyestrain.—Eyestrain results from such features of illumination as cause the muscles of accommodation of the eye (see chapter on Anatomy and Physiology) to work too continuously or too often in order to properly regulate the amount of light striking the retina and to accommodate for near and for distant objects. The principal features in illuminations producing eyestrain are insufficient light, especially when reading or writing, excessive light, flickering light, brilliant points of light, irregular reflection of light, and streaks or shadows on a reading or writing page. Continued use of strained eyes may result in permanent damage to the eye as well as reflex troubles such as headache, indigestion, etc.

Location of lights in a room and at desks.—Lights should be placed in rooms out of the field of vision, as on the ceiling. Desk lights should be so placed that the source of light is out of the field of vision of the individual using the desk, i. e., back of him, and also over his left shoulder in a right-handed man, so that an uneven illumination will not be produced on the writing page by the shadow of his hand.

Direct and indirect illumination.—Direct illumination is that which comes from a visible source; indirect illumination is that which results from placing the lamps behind a screen, the light thus being thrown on the ceiling and reflected downward. The latter is much better, as bright points in the line of vision are prevented.

Lighting of wards, sick rooms, and living spaces.—Wards, sick rooms, and living spaces should have plenty of sunlight. Patients should not have to face the windows or lights, as the constant glare of the light is trying and disagreeable to the eyes. The light should come from their backs or sides, and the windows should have shades, in order properly to regulate the light.

FOOD AND ITS RELATION TO HEALTH AND DISEASE.

Food may affect health as a result of—

- (1) Natural poisons contained therein.
- (2) Animal parasites contained within the food.
- (3) Plant parasites (bacteria) contained in the food.
- (4) Toxins developing in the food as a result of bacteria.

- (5) Special poisons contained in the food.
- (6) Poisons accidentally or purposely added.
- (7) Amount—too little or too much food.
- (8) Composition—unbalanced diet.
- (9) Disturbance of digestion and metabolism.
- (10) Food idiosyncrasy.

Natural poisons.—Foods may be natural poisons, as in the case of certain mushrooms, some fish, or the alkaloids in various species of plants.

Animal parasites.—Foods may convey animal parasites such as trichinæ, and the hog, beef, and fish tapeworms. These parasites, as a rule, occur as ante-mortem infections in the flesh of food animals. The larval stages of such parasites, which usually are destroyed by cooking, infect man as a result of eating insufficiently cooked foods. For a description of the life history of these parasites, see section on Animal Parasites of Man.

Plant foods also may carry the parasites and the eggs or larvæ of various animal parasites—the amœba, causing dysentery; the hookworm, causing hookworm disease; the ascaris, causing ascariasis.

Plant parasites.—Foods usually contain a number of bacteria. Both animal and vegetable foods may convey bacteria pathogenic in man. The principal diseases spread in this way are typhoid and paratyphoid fevers, bacillary dysentery, amœbic dysentery, cholera, tuberculosis, diphtheria, scarlet fever, and septic sore throat. The foods that ordinarily are eaten uncooked are most liable to spread disease. Milk and its products, above all others, is the food which most commonly transmits disease.

The so-called "food poisoning" usually is due to an infection with the Gaertner group of bacilli, or one of the other closely allied members of the colon-typhoid group. It was considered formerly that foods might be injurious as a result of ptomaine developing in the putrefaction of foods. This no longer is considered to be true, and all such food poisoning now is believed to be due to some type of infection.

Toxins.—Poisonous substances develop in the food as the result of bacterial activity. The only example of this group is botulism. Preserved foods, especially sausage, ripe olives, asparagus, and home-canned vegetables, may be contaminated with the *Bacillus botulinus*. The factory-canned products, which are subjected to very high temperatures, and closely inspected, rarely contain pathogenic bacteria.

Special poisons.—Foods may contain, at times, special poisons, as for example, solanin in sprouted potatoes, or ergot in rye. Poisoning has been reported from eating an excessive amount of rhubarb leaves.

Poisons accidentally or purposely added.—A great variety of poisons may find their way into food, either through accident or intent. Some of these, when added as preservatives in accordance with the Pure Food and Drugs Act, in very small quantities, are not considered as poisonous, but when added in large amounts, they are injurious to health. Such substances as arsenic, lead, caustic alkalies, acids, and many forms of adulterants are found in food substances from time to time. Poisonous substances also may form in the food as the result of the food acting upon the container in which it is preserved, i. e., if the container is not properly made. However, poisonous substances rarely develop in tin cans as made today of thin iron coated with tin.

Amount.—The health may be injured by eating too much or too little food. Thus, an excess of food predisposes to obesity, and perhaps to arteriosclerosis, as well as degenerative changes in the liver and kidney; an insufficient amount

of food undermines the health, and may bring about such changes as war edema, etc.

Composition.—An unbalanced diet affects growth, vigor, and health in many ways. A diet may be deficient in vitamins, organic acid compounds, or minerals, such as phosphate and calcium. A diet also may be deficient in one of the necessary constituents, fats, carbohydrates, or proteins, which will lead to disorders of metabolism or undernourishment. An insufficient amount of cellulose, or roughage, is a common cause of constipation. Highly spiced and stimulating diets are irritating, both to the digestive tubes and organs of excretion. An excess of carbohydrates favors fermentation; an excess of fat leads to acidosis; an excess of protein favors putrefactive changes.

Deficiency diseases.

Since the vitamins play such an important part in the known deficiency diseases, it may be well to discuss these in connection with certain deficiency diseases, which may be prevented by the inclusion of such substances in the diet.

Vitamins are accessory factors in the diet necessary for growth and metabolism. Their physical and chemical properties are not known; however, the effects of the lack of them in the food have been studied very thoroughly biologically. At present it may be stated that there are three distinguishable vitamins: Vitamine A, vitamine B, vitamine C.

Vitamine A is found abundantly in nature, in milk, butter, eggs, the fat of glandular organs, such as cod-liver oil, and also in the leaves of plants. The seeds of plants contain a lesser amount of this substance. Inasmuch as the seed contains this vitamine in the outer layers and germ cells, highly milled flour and polished rice contain practically none of it. Milk and green leaves of plants therefore are regarded as protective foods; one of these always should be in the diet. A lack of this vitamine in the diet prevents growth of the young, and will cause an inflammation and ulceration of the eye—*xerophthalmia*.

Vitamine B is widely distributed in many forms of natural foods. It is found in animal tissues, leaves, and tubers. It is never associated with fats or oils of either animal or plant origin. The ordinary food of our diet contains several times the amount of water soluble vitamine B, which is necessary to the maintenance of growth and health in animals. As with vitamine A, it is found in seeds in the outer layers and germ cells. A deficiency of this vitamine in the diet brings about a disease known as *beriberi*.

Vitamine C is abundant in the juices of fresh sweet limes, lemons, sauer kraut, milk, and fresh potatoes. A lack of this vitamine brings about a condition known as *scurvy*.

Other than scurvy, beriberi and xerophthalmia, *rickets*, and *pellagra* are believed to be due to a deficiency in diet. Rickets is due to a lack of a vitamine recently described and certain other substances in the diet such as salts, as well as to poor hygienic conditions.

Pellagra is believed to be due to a diet which contains improper types of protein. There are 18 to 20 different amino acids in protein foods. Seven or eight of these are essential. If some of these seven or eight are lacking, the condition spoken of as pellagra is brought about.

All of these dietary deficiency diseases may be prevented by supplying the substances lacking in the diet. For instance, beriberi may be prevented by supplying the body with legumes and other vegetables; scurvy, by supplying

the body with lemon and orange juice, fresh potatoes, milk, etc.; pellagra, by supplying the body with fresh animal food, milk, and legumes.

Disturbance of digestion and metabolism.—Foods, otherwise wholesome, may be injurious on account of faulty digestion or disturbances of metabolism. The common causes of such troubles are eating too fast, imperfect mastication, eating when fatigued or overheated, injudicious combinations, especially unripe fruits or vegetables containing raw or partly cooked starch, etc.

Food idiosyncrasy.—Food poisoning of this nature is anaphylactic in character. It is usually impossible to determine how or when the idiosyncrasy was acquired, and sometimes it is difficult to determine the particular article of diet responsible. Some people develop a rash or other symptoms when eating sea food, others when eating strawberries, eggs, tomatoes, and many other types of foods.

For a description of the classes of foods, use of foods, values of food, and pasteurization of milk, see chapter on Food and Dietetics.

For methods of preservation and inspection of food, and the manner in which it is adulterated, see chapter on Commissary Work.

WATER AND ITS RELATION TO HEALTH AND DISEASE.

Although water is not classed technically as a food, it is an essential article of diet, for the body requires for its daily physiological use from 1,800

to 2,100 c. c. of water, ingested as such, with approximately 600 c. c. additional, ingested with solid food. Moreover, it bears an important relationship to personal hygiene, inasmuch as it is essential for the maintenance of proper cleanliness of the person, the clothing, and other objects with which man comes in contact. Furthermore, water bears an important relationship to certain diseases, particularly the communicable diseases, as it offers an important route in the transmission of several species of infective agents.



FIG. 143.—Shallow well penetrating limestone. (Rosenau.)

Sources of water supply.

The sources of water supply are, as a rule, rain water, surface water, and ground water. In addition, the Navy obtains much of its water supply by means of distillation.

Rain water, when collected under sanitary conditions, is the purest of all natural waters. However, this source of water supply, on account of the careless manner in which the water is stored or collected, may be dangerous, because of the fact that the surfaces upon which the water is collected are usually dirty.

and the cisterns or rain barrels in which the water is stored offer breeding places for mosquitoes and easily may become polluted.

Surface water.—Included in this class are waters from rivers, lakes, ponds, of impounding reservoirs. Since rivers and creeks often are used as natural sewers, water obtained from this source should not be used unless treated by one of the means described below.

Ground water is obtained from springs, shallow wells, and deep artesian wells. Springs are formed when ground water—water above the first impervious stratum of the earth's surface—is caused to overflow upon the surface as a result of geological formation. They often are found to be polluted in the same manner as are rivers and creeks. Provided the drainage area around the spring is protected properly, this offers a good source of water supply, *i. e.*, if the springs are not in limestone regions. (Fig. 143.)

Shallow wells, unless properly constructed, are dangerous. However, when properly constructed and located in sandy soil—not limestone country—they offer an excellent source of water supply. (Fig. 144.) It should be remembered that surface water is purified as it percolates through fine sandy soil. This is nature's process of filtration; the organic matter is oxidized and the bacteria are strained out largely by biological action. The soil can take care of a large amount of pollution, and, if not overburdened or if the geological formation is such that it has no cracks or crevices, the ground water may be entirely free from objectionable substances and bacteria. (Fig. 145.)

Artesian wells, in contradistinction to shallow wells, are wells which penetrate an impervious stratum of the earth's surface. Water obtained from this source furnishes the safest and most satisfactory water supply. Such water is usually clear and of high sanitary quality. (Fig. 146.)

Distilled water.—The process of distillation of water aboard ship is as follows: Water from over the side is pumped into the evaporators which contain steam pipes. This water is heated and the steam thus generated is condensed by cold water from over the side circulating around the steam pipes in the distillers. The pure distilled water then is led into tanks where it is aerated. If boiling is too energetic in the evaporators, droplets of salt water pass over into the distillers and cause the distilled water to contain chlorides,

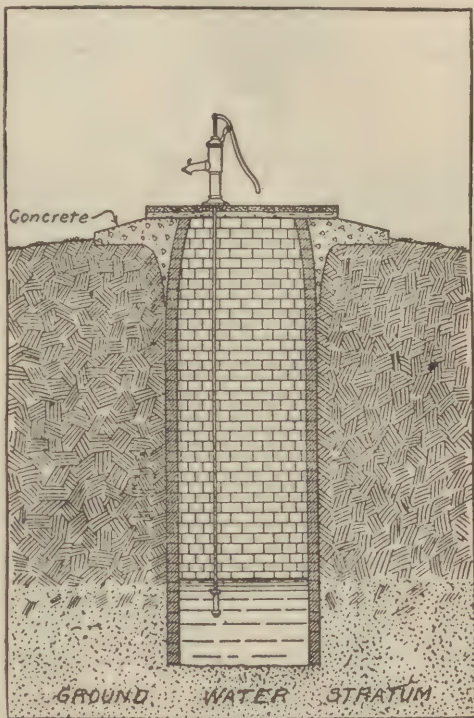


FIG. 144.—A model well, cased with brick laid in cement mortar and properly graded, curbed, and protected. (Virginia Health Bulletin.)

and hence have a salty taste. This commonly is spoken of as priming. From a hygienic standpoint, it is not dangerous, as all pathogenic bacteria are killed by the boiling of the water. However, if there is a leak in the distiller tubes, the cool, untreated circulating water coming from over the side may infect the distilled water as well as add chlorides to it. (Fig. 147.)

Sanitary analysis of water.

Since water bears such an important relationship to disease in connection with the transfer of infective agents, it is essential that information concerning its past history should be secured. A proper sanitary analysis of water includes:

(1) A physical examination to determine odor, color, turbidity, and taste.

(2) A microscopic examination to determine the number and character of the particles in suspension, especially algae.

(3) Chemical examination to determine the amount and nature of chemical impurities.

(4) A bacteriological examination to estimate the number and kind of bacteria, the *B. coli* being the most important.

(5) A sanitary survey of the watershed, including methods of collecting, handling, storing, and disturbing the water.

The last is the most important of all the procedures outlined above.

Purification of water.

The following are the methods used in the purification of water:

(1) Clarification by sedimentation.

- (a) Aluminium sulphate.
- (b) Iron and lime.

(2) Filtration.

- (a) Slow sand filters.
- (b) Rapid mechanical gravity filters.
- (c) Pressure filters.

(3) Sterilization.

- (a) Chlorine.
- (b) Ultra-violet rays.
- (c) Ozone.
- (d) Copper sulphate.

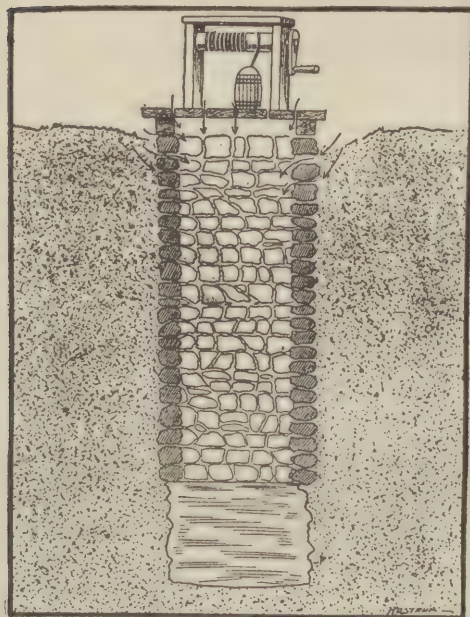


FIG. 145.—A type of dangerous well frequently found in use. The openings in the top and around the mouth of the well allow the entrance of polluting matter such as may be brought from the stable or privy on the feet of persons or poultry; the rough masonry of the walls makes contamination through the soil easy; the handling of the buckets and chains may cause gross contamination and immediate introduction into the water of the germs of typhoid fever or of other diseases. (Virginia Health Bulletin.)

Sedimentation may be brought about by allowing the water to stand in large surface ponds, or by lowering the velocity of a stream. This method is used largely to remove turbidity, and is of little value in the removal of bacteria.

Sedimentation is hastened by the use of coagulents, aluminium sulphate, or iron and lime. Coagulents must be supplied to water before the water is passed through rapid mechanical filters.

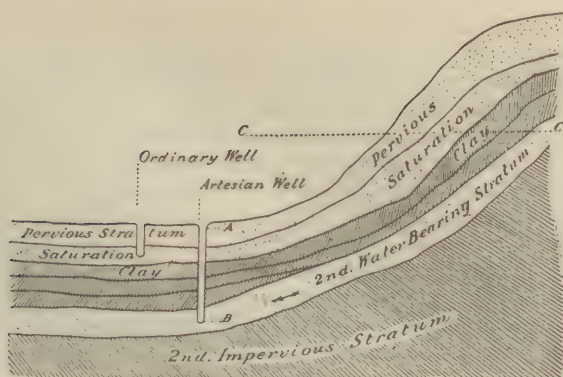


FIG. 146.—Geological formation favorable to the obtaining of water by means of artesian wells. (Harrington.)

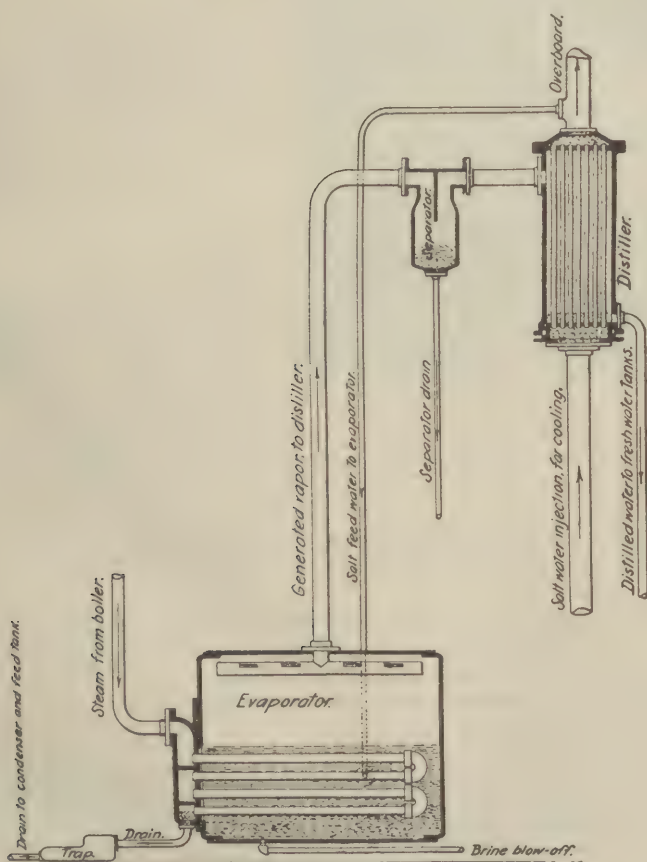


FIG. 147.—A diagram showing the general plan of the apparatus used for distilling salt water on board ship. The salt water is evaporated by means of steam coils which pass through it. The vapor is then distilled, being cooled by passing around pipes in which salt water is circulating. (Gatewood.)

Slow sand filtration.—This is accomplished by large filters, either open or covered, about an acre in extent, consisting of tiles overlaid with gravel and coarse and fine sand in a sealed concrete basin. The bacteria are not removed by a straining process of the sand grains, but as a result of the action of age and protozoa which collect in the interspaces in the surface layers of the sand, and have direct action on the bacteria. No preliminary treatment with coagulents is necessary with slow sand filtration. (Fig. 148.)

Rapid sand filtration.—Pressure and rapid gravity filters are used for this purpose. The operation of each type of sand filter is based on the same principles. Filtration is brought about by the formation of films of the coagulant around the grains of sand and on the surface through which the water passes, either by gravity or pressure. The coagulant usually used is aluminium sulphate, or iron and lime combined, the coagulant being added in the sedimentation basin.

This is the type of filter usually employed in the Navy. Inasmuch as these filters clog very rapidly, they have to be washed frequently, usually every 24

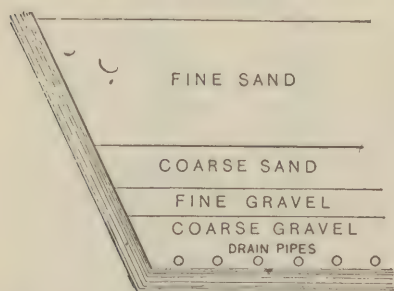


FIG. 148.—Schematic drawing of slow sand filter. (Harrington.)

hours or oftener. They are cleaned in two ways: (1) By reversing the flow of water and mechanically raking the sand, and (2) by reversing the flow of water and passing an air current through the filter, which agitates the sand.

The gravity filters, or open filters, are reservoirs of wood or concrete. The pressure filters are cylindrical tanks.

Sterilization of water.

In the Navy and in the United States generally chlorine is used largely for

this purpose. It may be applied either as liquid chlorine or as a solution of bleaching powder. The chlorine usually is added after the water has been filtered, in the proportion of one-tenth to five-tenths part per million.

Chlorinated lime, or bleach (30% available chlorine), frequently is used in the Navy for the sterilization of small quantities of water in Lyster bags, or in tanks aboard ship. It should be added in the proportion of 1 gram per 40 gallons.

The ultra-violet ray is used largely in the Navy for the sterilization of water for swimming pools. Such water must be filtered before being exposed to the ultra-violet rays.

Ozone is not used in the Navy for the sterilization of water, but is used extensively in Europe and, to some extent, in the United States. The water also must be filtered before it is exposed to ozone.

Copper sulphate is used to clear the water of algae.

Water supply on the march and in camp.

Water supply.—No water other than distilled, boiled, or chlorinated water should be used for drinking or cooking purposes. Previous sedimentation and filtration is desirable, and for this purpose barrels or boxes containing pebbles, sand, and charcoal may be used. The pebbles and sand should be disinfected by prolonged heating before the filter is constructed.

The camp water supply, even in temporary camps, should be placed under sentry supervision.

For chlorination of drinking water in camp use one ampule, each containing 1 gram of calcium hypochlorite, for every 40 gallons of water, and allow to act for at least one hour before drinking. This should be done in Lyster bags when practicable.

For use on the march, make a stock solution by dissolving the contents of one ampule in a canteen full of water. Use $1\frac{1}{2}$ teaspoonfuls of stock solution (more exactly, 6.5 c. c.) to chlorinate one canteen full of water. To chlorinate one bucket full (3.5 gals.) of water, use 88 c. c., or approximately one-half glass, of stock solution.

The chlorination of water may be tested after 30 minutes by adding 10 drops of starch-iodide solution (potassium iodide, 10 per cent, soluble starch 1 per cent, and zinc sulphate, 0.5 per cent) to a cup full of water. The appearance of a blue color indicates that sufficient chlorine has been used. If no color appears it shows that the hypochlorite is of inferior quality or the water is probably lightly polluted.

In order to avoid under-chlorination and also the taste resulting from over-chlorination, the following method is recommended: The contents of a tube of calcium hypochlorite (1 gram) are added to a Lyster bag of raw water, stirring the powder in well and allowing the water to stand from 10 minutes to half an hour, depending upon the physical condition of the water. (Fig. 149.) A test should be made immediately after adding the hypochlorite to make sure that an excess is present, and it is desirable that a second test be made at the end



FIG. 149.—Lyster bags supported by stacked litters. (Ford.)

of the sterilization period. These tests may be made by adding half an ampule of a solution of orthotoluidine (0.1 per cent orthotoluidine in 10 per cent solution of hydrochloric acid in 1 c. c. ampule) to a small quantity of the treated water contained in an ordnance cup. In the presence of free chlorine a coloration is produced which ranges in shade from a light canary-yellow to a dark red, depending upon the amount of free chlorine present. At the end of the sterilization period the rank taste and odor of the sterile water may be removed by adding 1 gram of sodium thiosulphate, and the water is ready for drinking. The small quantity of thiosulphate added is scarcely sufficient to alter the taste of the water; indeed, it is difficult to differentiate by taste between raw water and water that has been thus treated. The amount of sodium thiosulphate remaining after treatment is negligible, since only 1 gram is added originally to the 38 gallons of water, and the greater part of this is used up in the reaction with the free chlorine. In this method the tube of calcium hypochlorite should be emptied directly into the bag full of water and rapidly stirred in by means of a stick. This stick should be left in the water throughout the whole process of treatment, for, if removed and then later used to stir in sodium thiosulphate, it may serve to reinfest the water

If the test fails to reveal a definite yellow color after the addition of one tube of calcium hypochlorite, another tube should be added and the water again tested.

The main feature of the above procedure is that polluted water may be considerably overdosed with calcium hypochlorite so as to insure effective sterilization, and then made palatable by dechlorination.

DISPOSAL OF SEWAGE AND REFUSE.

The term "sewage" includes not only human excreta, solid and liquid, but also the waste water and impurities coming from human habitations. By "refuse" is meant the waste of a city, camp, navy yard, station, etc., other than sewage, and includes garbage, ashes, rubbish, street cleanings, and manure.

Sewage.

The basic principle that underlies all methods of sewage disposal is to get rid of the sewage as speedily as possible with the least nuisance to the smallest number of people, with the least danger to health and property, and at the smallest cost.

All methods of sewage disposal fall under two general heads—the "water carriage system" and the "dry system." The "*water carriage system*" is based upon the principle of removing a burden from the community to another place, and may be used wherever there is an available water supply for flushing purposes. Such systems are used at all of our naval shore stations in the United States, and aboard all of our ships. There are several general means of disposal of sewage by the "water carriage system."

Dilution.—This is the oldest, simplest, cheapest, and where practicable, the best method, taking advantage, as it does, of the ability of bodies of water to purify themselves. The process of purification depends upon certain chemical and biological changes for which a sufficient supply of free or "dissolved" oxygen in the water is essential. Under suitable conditions, the complex organic matter is broken up and oxidized by bacteria into simpler forms, such as nitrates, carbon dioxide, and water. Bacteria are food for protozoa, the dissolved matter for algæ; protozoa and algæ are food for rotifers and crustacea, and these in turn for aquatic animals and fishes. These animals require oxygen and produce carbon dioxide, while plants consume the latter and produce oxygen. If the chemical balance is disturbed, the biological cycle described above is broken and a nuisance follows.

The determining factors as to suitability of this method are:

(a) Amount and character of water in the receiving body with reference to dilution and available dissolved oxygen.

(b) Current, with reference to diffusion and transfer and as to constancy of flow, whether constant in direction and force or tidal.

(c) Proximity of outfalls to intakes for water supply, and to bathing beaches or shellfish areas.

The sewage of all ships is disposed of by the dilution method. As a rule, most of our ships are in salt water, and this is a perfectly safe method of disposal of sewage. However, a few of our ships are in bodies of fresh water, such as the ships in reserve in the Great Lakes. These ships tend to pollute fresh water, but are really not a nuisance inasmuch as a far greater amount of sewage is emptied into these bodies of fresh water by the cities or towns adjacent thereto.

Sewage treatment.—At some of our naval stations ashore the sewage is treated before it is emptied into adjacent bodies of water. In the treatment of sewage, the following results are sought:

1. The separation of suspended matter from the liquid sewage.
2. Destruction of organic matter in the liquid sewage.
3. The destruction or removal of bacteria from the effluent of treatment plants.

Several methods are employed to secure these results. In any method used, great care and judgment must be employed in the operation of the plants. The treatment of sewage may be divided into two general systems—the preparatory process and the purification process.

Sewage may be prepared for purification by the following means:

1. Screens: To remove coarse material.
2. Sedimentation: To remove relatively heavy suspended matter.
3. Settling tanks: Large basins which retain the sewage from 1 to 12 hours, permitting sedimentation of fine particles, organic and inorganic.

4. Septic tanks: These are sedimentation tanks designed to retain the sewage from 8 to 24 hours. This process, aside from the physical sedimentation of solids, depends upon anaërobic bacterial action. Baffles are arranged to retard the flow. Sludge remains for long periods, affording opportunity for intensified bacterial action under anaërobic conditions. Some of the solid organic matter is digested or reduced; a heavy scum is formed on

the surface and there is a continual rising and falling of sludge as a result of the gases formed. The quality of the effluent water leaving a septic tank is not materially improved over raw sewage. It may be foul smelling and septic action can not be depended upon to render sewage safe in so far as the spread of infection is concerned. The septic process does result in breaking down solids, and therefore these tanks may be very useful in connection with sprinkling filters or other oxidation methods. (Fig. 150.)

5. Digestion tanks: Various attempts have been made to remove the objectionable features of the original Cameron septic tank just described. The best known and most successful substitute is the Imhoff digestion tank. This is a deep tank, divided into an upper and lower compartment by sloping partitions, between which is left an open slot. (Fig. 151.)

Under this slot there is an inverted V-shaped trough, the base of which is wider than the slot. Sewage is admitted into and flows through the upper chamber. There should be multiple inlets and baffles to distribute the sewage. As it travels along, matter heavier than water settles and escapes through the slot into the lower compartment, where digestion takes place. Gases formed in the sludge rise vertically and can not escape into the upper tank because of the

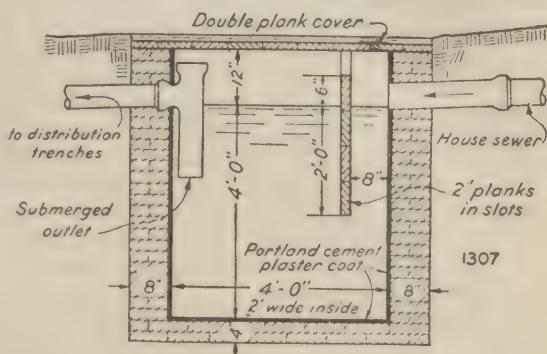


FIG. 150.—Septic tank for small numbers of persons. Brick construction, heavily plastered inside; size suitable for 180 to 280 gallons of sewage daily (nominally 4 to 7 persons). (U. S. Public Health Reports.)

inverted trough. The gases are allowed to escape through openings directly from the lower chamber into the outside air. One of the principal objections to the old septic tank is thus obviated; the continual disturbance of the sewage by gases rising forcibly from the sludge seriously interfered with sedimentation in the one-story tank. Whereas in septic tanks sewage must be allowed to remain from 8 to 24 hours, even then yielding a foul effluent as an end result, tanks constructed on the new two-story Imhoff design are capable of removing a higher percentage of settleable matter from the sewage in retention periods of from two to three hours, with a fresh inodorous sludge of low-water content and small bulk. The disposal of sludge is usually a big problem, so the small bulk and low-water content of Imhoff tank sludge is in itself a great asset.

About 65 to 75 per cent of suspended matter and from 25 to 75 per cent of the contained bacteria are removed from medium-strength sewage by this treatment.

Imhoff tanks, or septic tanks, can be of wood or concrete construction, and the size should be calculated to allow for not less than two hours' delay, or one-twelfth of the daily flow plus about 50 per cent to allow for peak loads. For example, a station having a complement of 1,200 men with a daily per capita water consumption of 100 gallons would have under a "separate"

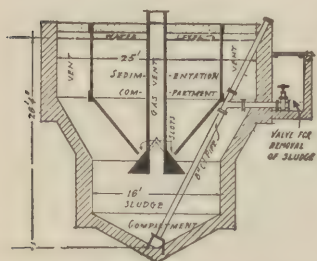


FIG. 151.—Imhoff sedimentation tank, sectional view. (Modern Hospital.)

system roughly 120,000 gallons of sewage to be disposed of each day, or an average of 5,000 gallons per hour. A tank designed to provide for a two-hour delay obviously must have a capacity of 10,000 gallons. With the additional allowance for peak loads the tank therefore should have a capacity of 15,000 gallons. If a combined system is used a further allowance naturally must be made for storm water. Capacity should be reckoned on the upper-chamber contents.

It should be remarked that a new Imhoff tank, or septic tank, if put into use without giving it a start with the proper bacteria and other flora, may not work efficiently for some months; it should, therefore, be "seeded" with a few buckets of sludge or manure. When sludge is removed some of the fresher sludge should be left in the tank for the same purpose.

Purification.—The purification processes are designed to free the fluid coming from the various types of sedimentation basins of as many bacteria as possible and of disagreeable organic matter.

The following methods, all of which depend upon aerobic bacterial action, are used:

1. Subsurface irrigation. The water coming from the tanks is discharged intermittently through one or more systems of open hollow-tile pipes, placed from 12 to 18 inches below the surface of the soil. The liquid thus is discharged into the subsoil, where bacterial activities are greatest.

2. Surface irrigation. The sewage from tanks is discharged into trenches on cultivated land and allowed to permeate the soil.

3. Intermittent sand filtration. Filters similar to slow sand filters described on page 290.

4. Contact beds.

5. Trickling filters.

Finally, at some naval training stations, and in many cities of the United States, the water emanating from the sewage after being treated is further treated with chlorine.

In the *dry system* faecal matter is received in pails, water-tight receptacles, pits, or latrines. This system is suitable for isolated houses or small groups of houses, for temporary camps, where the natural drainage is into a public water supply which must be protected, or where no water for a water carriage system is available. The safety of the system depends upon proper care by user and collector; cleanliness in handling, prompt and frequent collection, disinfection of receptacles, protection of faecal material against flies, and incineration or burial in a suitable locality.

Refuse.

Aboard ship.—The disposal of refuse aboard ship is not a great problem. Dry refuse, such as paper, boxes, etc., is disposed of by burning in the fire boxes of the boilers on coal-burning ships or on modern ships in incinerators. Tin cans are disposed of by puncturing and then throwing over the side. Wet garbage, such as waste from meals and galleys, is disposed of by placing it in slop chutes.

Some port regulations are to the effect that no garbage or other refuse may be thrown into the harbor. Under such conditions, tin cans, etc., have to be placed on specially provided lighters, which are brought alongside at regular intervals. On coal-burning ships, ashes have to be disposed of in a similar way in harbor. At navy yards refuse from ships is disposed of on the dock in specially provided garbage containers, which are cared for by the yard forces. The ships are required to keep such places clean and free from odor as long as they are being used by individual ships.

In time of war ships are not permitted to throw garbage or tin cans over the side. During daylight there are specially constructed bins which collect and hold all garbage until nighttime, when the entire bin is dumped. The reason for this is that a fleet or a ship may be traced by the floating refuse which is thrown over the side. Under such conditions the medical officer of a ship should pay particular attention to large garbage bins. Although no diseases may be disseminated in this way, the bins are a nuisance unless kept clean.

Disposal of refuse ashore.—Refuse should be collected from the galleys, barracks, houses, etc., in specially provided water-tight containers, which are covered to prevent the access of flies. The refuse should be separated, ashes being put into one can; tin cans into another; paper and wood, etc., into another can; and wet garbage in a separate can.

Tin cans may be of value; if there are a sufficient number, they may be sold. Otherwise, they will have to be disposed of by dumping at a convenient place, in order that the odors emanating therefrom will not be a nuisance.

Dry rubbish, such as wood, paper, etc., should be burned in an incinerator, which is provided at all such stations.

Kitchen refuse may be disposed of in one of three ways:

(1) By feeding to hogs. Some stations have maintained a hog farm, and this has been profitable.

(2) By selling garbage to contractors. Contractors use this garbage either by feeding to hogs, or by extracting the fat and other material from it.

(3) By incineration. This is the most costly method, and perfectly good food material is being wasted. But where it is impossible to maintain a hog farm in the near vicinity of the station, such as the station in the city of New York, it is more economical to incinerate the garbage than to haul it long distances. Ashes on shore should be used to fill in low lands, but unless the ashes are kept separate from the rest of the refuse it is likely to be a nuisance.

Manure.—Inasmuch as manure offers such an ideal breeding place for flies, it should not be allowed to accumulate around corrals or stables. The manure may be disposed of by being taken away every morning and spread out thinly so that it will dry. Or it may be placed in fly-proof bins and held there until it is hauled away. Manure may be sprayed with a solution of hellebore or borax, to kill maggots and at the same time preserve it as a fertilizer. It also may be burned, but since manure is valuable as a fertilizer, this rarely is done.

PERSONAL HYGIENE.

By personal hygiene is meant any measures taken by the individual by which he can avoid disease and promote his health and strength. These measures include the eating of the proper amount and kind of food, drinking the proper kind and amount of water, the wearing of proper clothing to suit the temperature, the breathing of wholesome air, all of which tend to heighten resistance; the avoidance of habits and practices which are liable to contract or transmit infectious diseases such as those borne by the mouth, nose, throat, intestinal, venereal secretions, etc.; the proper use of the eyes; all of which have been touched on in preceding sections. Cleanliness of the person and clothing is one of the first requisites for good health. A daily bath should be taken when practicable. The hair should be kept short, finger nails kept trimmed and cleaned, teeth brushed twice daily, and the exposed parts of the body, face, and neck bathed frequently, and the armpits and genitals at least once a day. Dirty bodies and dirty and infected clothing are very often the cause of skin and other diseases.

Effect of proper exercise on health.—With proper exercise, the elimination of waste products from our bodies is increased through deeper breathing, more perspiration; the muscles and heart become better nourished by more rapid metabolism, and a better circulation improves all the other functions of the body; the digestion is improved; and resistance to certain diseases is increased.

Care of the bowels.—The bowels should move daily, otherwise poisonous substances are absorbed into the system. If proper food is eaten and proper exercise taken, the bowels generally will look after themselves.

Effect of the mental state on health.—A cheerful state of mind promotes and benefits all the functions of the body and vice versa.

Dental hygiene.—(See section on Dental First Aid.) By dental hygiene is meant the care of the teeth and mouth. The teeth should be brushed at least twice a day, and preferably after each meal, the object being to prevent decomposing matter from resting on the teeth: a clean tooth does not decay. The structure of the toothbrush and manner of brushing the teeth should be such as to insure the removal of all food particles and foreign matter from around and between the teeth; this always is done more readily by the use of a good toothpaste. One should have the teeth scraped and cleaned periodically by a dentist in order to have removed the hard calcareous matter that may accumulate at the margins of the gums and which tends to cause recession of the gums and pyorrhœa. Pyorrhœa is an infectious inflammation of the gums and a most difficult condition to cure and this, together with recession of the gums, frequently results in the loss and decay of teeth. Whenever a decayed condition is noted in a tooth, one always should go to a dentist for prompt treatment while the tooth yet may be saved. Improper care of the mouth and teeth results in infection at the roots of the teeth, and from here, the infectious microorganism may gain access to the blood and set up conditions such as articular rheumatism with perhaps heart disease, Bright's disease of the kidney, severe neuralgias, besides such local conditions as alveolar abscess with toothache.

CLOTHING.

The chief purposes of clothing are:

1. To maintain the temperature of the body, and, by preventing the loss of animal heat, to diminish to some extent the demand for food.
 2. To hinder as little as possible the chief heat-regulating mechanism, viz., evaporation from the skin.
 3. To afford the greatest possible freedom to all muscular acts and to avoid the compression of the body.
 4. To protect the body from heat, cold, wind, and rain.
 5. To protect against mechanical injury, frost, or the direct rays of the sun.
- The value of any material for clothing purposes depends upon:
1. The slowness with which it permits the passage of heat to or from the body.
 2. The slowness with which it permits the evaporation of water.
 3. The amount of air its meshes contain.
 4. Its impermeability to the wind.
 5. Its adaptability to some special purposes.

The materials from which clothing is made are derived from:

1. The animal kingdom: (a) Silk, (b) wool, (c) leather, (d) fur.
2. The vegetable kingdom: (a) Cotton, (b) linen. (c) papers and other fibers.

Silk.—This is an excellent nonconductor of heat, is almost as hygroscopic as wool, and affords a warm clothing. It takes coloring matter easily, and is therefore of value from an æsthetic standpoint. It is an excellent material for undergarments. Its great disadvantage is its high cost.

Wool.—This is obtained from the hair of many animals, viz., sheep, goats, camels, alpacas, etc. In a general sense it is probably the most valuable of clothing materials, because:

1. It usually is worn in such a way as to entangle large quantities of air in its meshes, and thus prevents either sudden lowering or raising of the body temperature, because dry air is a good nonconductor.
2. It is very hygroscopic: readily taking up water and perspiration, and giving them off slowly, thus reducing "the cooling by evaporation" to a minimum, and regulating the heat dissipation of the body.
3. When saturated, it still permits the passage of air through its substance.

Its disadvantages are that:

1. It can not be worn next to the skin.
2. It absorbs odors.
3. It shrinks quickly if washed carelessly.
4. It readily wears out.
5. It is moderately expensive.

Leather.—This is used chiefly as foot coverings on account of its durability, pliability, and imperviousness to moisture. It is used in cold countries because it resists the force of the wind and efficiently surrounds the body with a layer of warm air.

Fur.—This protects against the wind and the cold on account of the impermeability of the skin, and of the large quantity of air entangled in the fur itself. It is heavy and expensive.

Cotton.—This is used more generally for clothing than any other material. It is hard and durable, but not as hygroscopic as wool. If smoothly woven and of light color it makes cool garments for warm seasons. For cold seasons,

it should be made to resemble wool by having large air spaces in the fabric and by being made of some dark color. It should not be worn while exercising, unless removed immediately thereafter, because it permits too rapid evaporation and cooling. It does not shrink, is very nonabsorbent of water, and conducts heat less rapidly than linen, but more rapidly than wool. It is very absorbent of odors. Its chief advantage is its cheapness.

Linen.—This is valued for its durability and for its purity of color when bleached. Its hygroscopic and heat-conducting properties are about the same as those of cotton, but it is more expensive than cotton. It is excellent for clothing in the Tropics, but soils easily. It is cooler, smoother, and less irritating to the skin than cotton.

Paper.—This is used extensively in countries where poverty prevents the use of the more favorable materials. Its use is quite common among the Chinese and Japanese, and it was used extensively by the Germans during the recent World War. Paper is warm because of its impermeability.

The most important use of clothing in cold climates is to protect against cold. This is accomplished by diminishing the radiation of heat from the body. The radiation of the heat from the body diminishes with the number of layers of clothing worn, because with each new layer of clothing we add another layer of air. Warm clothing depends upon the following factors:

1. The capacity for retaining the natural body heat.
2. The color. Color absorbs heat in the order named herewith. Black, dark blue, light blue, dark green, red, light green, light yellow, pale straw, white.
3. The degree of porosity. Flannel is the most porous, silk the least porous. Starching and ironing tend to close the pores in clothing and render it more impervious. The wearing of unstarched clothing in hot weather is, therefore, more comfortable. In winter, starching and ironing serve to conserve the heat of the body.
4. The surface finish. Rough surfaces are generally warmer than those which are smooth, because the rough surfaces stimulate the skin and favor capillary circulation.
5. The hygroscopic properties. The hygroscopicity of the various materials is as follows: Wool, fur, eiderdown, linen, cotton.
6. The number of layers. With each new layer of clothing, in addition to getting the benefit of an additional thickness, we get also an additional layer of air, thus adding another good nonconductor and diminishing the radiation of heat from the body.
7. The texture. Loosely woven clothing has more air in its meshes, and is, therefore, a better nonconductor of heat. A loosely woven cotton cloth, such as bath toweling, may be warmer than a finely woven woolen cloth, because it will absorb a slightly greater quantity of water.

Infected clothing.

Clothing, linen, and other garments are capable of holding a relatively large number of microorganisms and vermin. The number of bacteria found is in direct ratio to the number of days the garment has been worn (clothing in contact with the body). Wool has a greater capacity for germs than cotton or silk. Under all conditions pathogenic bacteria contained in clothing gradually die out. There is also a progressive decline in the power of development of bacteria, as they undergo a gradual diminution in virulence. This virulence they can retain in clothing for a considerable, but not indefinite, time.

VITAL STATISTICS—METHODS USED IN THE UNITED STATES NAVY.

The importance of vital statistics to the practice of preventive medicine can not be overstated. Without the statistical method comparatively little progress would have been made in epidemiology and less toward the prevention and control of disease.

The statistical method is the method of presenting facts in numerical form in order that they may be studied in comparison with other facts, numerically stated or otherwise.

Vital statistics are the numerical presentation of facts relating to sickness, deaths, births, and marriages for the population (or complement) as a whole, or for specified groups or classes. Vital statistics commonly are prepared

INFLUENZA EPIDEMIC, U.S. NAVY.

JANUARY 7—APRIL 1, 1922.

RATIOS PER 1,000.

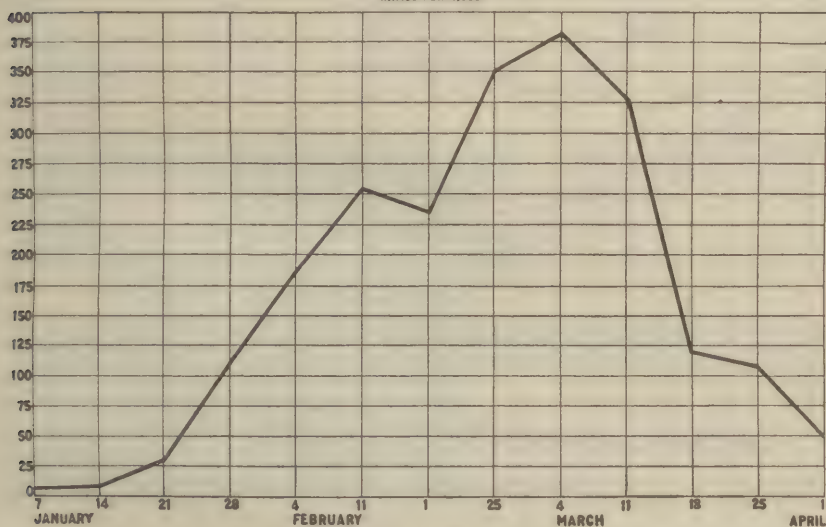


FIG. 152.—Type of arithmetical chart.

specifically for the following population groups or classes: Sex, age group, race and color, occupational group.

Statistics may be prepared for subgroups of these; for instance, whites of the male sex, belonging to the age group, 20 to 29. Furthermore, it may be that only males of a particular occupational class are under consideration.

Graphic methods for presenting statistics.

Although statistics present facts for study in the form of numerals, their significance can not be grasped always until the statistical facts have been further presented in graphic form—curves, lines, bar charts, spot-pin maps, pin charts, etc. (Figs. 152, 153, 154.)

Graphic records are constantly necessary in statistical work for the following reasons:

(1) They make it possible to perceive instantly facts which otherwise might be concealed or discovered only after careful study.

(2) They make it possible to place before the eye at one time, in understandable form, information which otherwise could not be presented without long tables of figures accompanied by long and involved explanation.

(3) They facilitate comparison of facts with other facts, closely correlated, remotely related, or, perhaps, as determined by study, bearing no relation whatever.

(4) By their means it is possible at times to make a person untrained in the statistical method perceive certain facts and appreciate their significance when by other means he could not be made to understand.

(5) Either the relation or the possible relation of one set of facts to another set of facts, and still other facts may be recorded pictorially on a single chart or map.

ANNUAL ADMISSION RATES PER 1000,
MALARIA, MEASLES, MUMPS AND PNEUMONIA.
1921

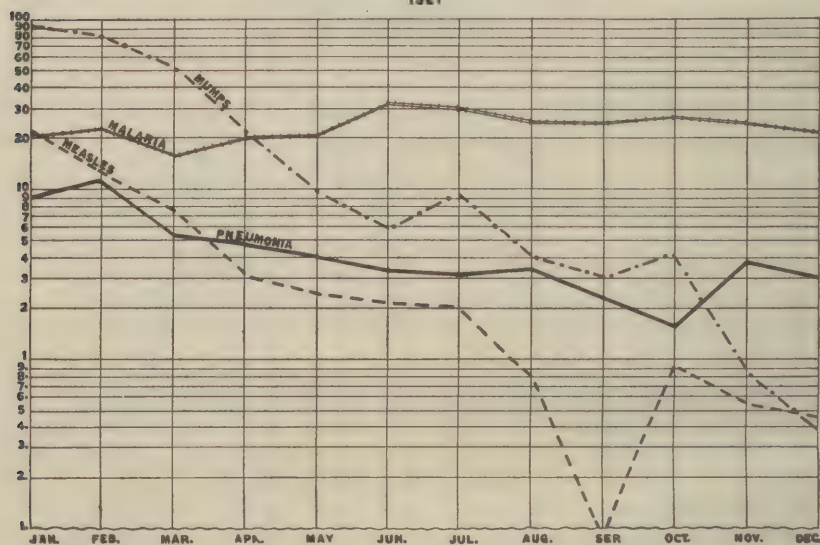


FIG. 153.—Type of logarithmic chart.

(6) In conjunction with the records for previous corresponding periods of time, graphic records show the trend of current events and sometimes enable one to look into the future for a short distance.

In administrative work the routine use of graphic records insures that important information which otherwise might be buried in the files and forgotten will be kept in view. Frequently such records can be used to advantage in attempting to convince other persons of the necessity for certain preventive measures.

Subject matter of the vital statistics of the Navy.

In the Navy vital statistics are limited almost exclusively to morbidity statistics and mortality statistics. In a few instances—Virgin Islands, Guam, Samoa—birth and marriage statistics are collected for the civilian population.

The subject matter of vital statistics of the Navy is composed of—

1. Basic data.—(a) Individual morbidity reports, i. e., the Form F card, which shows the diagnosis and certain attending circumstances for each admis-

sion to the sick list. (b) Individual mortality reports; the death certificate, Form N.

2. Summarized written or telegraphic reports of new cases and deaths.

3. Compilations, i. e., tables or tabulations showing cases, deaths, or rates.

4. Graphic charts, spot maps, or charts posted by means of colored spot pins.

Correct vital statistics depend upon the accuracy and completeness of the basic data. Morbidity returns are incomplete when mild cases of a disease are not reported, and incorrect when erroneous diagnoses are recorded. A morbidity report is incomplete when any of the data required on the form is omitted. Mortality reports are incomplete when any of the required data are omitted, and incorrect when sufficient collateral evidence to insure correct classification of the death with regard to cause is missing. The death certificate also must contain the necessary information to enable the bureau to charge the death to the station or ship where the disease or injury resulting in death was acquired, and not to the place where death occurred—in a naval hospital, perhaps.

OCCUPATIONAL GROUPS OF THE U.S. NAVY—ALL CAUSES

1921.

RATIOS PER 1,000.

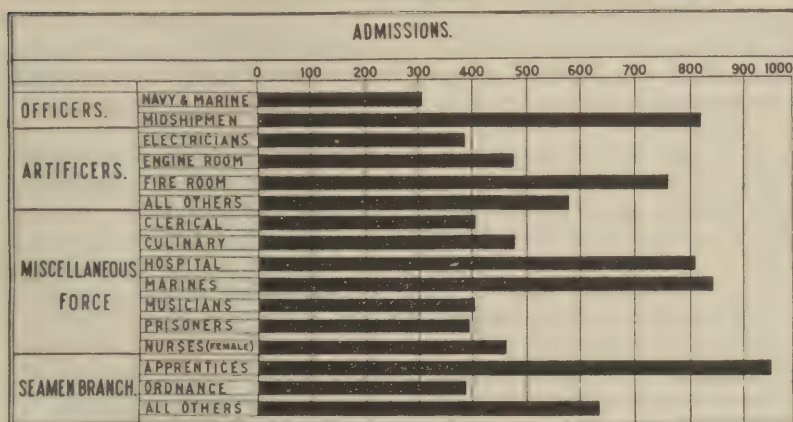


FIG. 154.—Type of bar chart.

Purpose of vital statistics.

The immediate and most important purpose, from the standpoint of preventive medicine, is to furnish information as to when, where, and under what circumstances, disease is occurring. It follows, therefore, that morbidity and mortality reports invariably should be made as promptly as possible. Reports should be forwarded promptly as a matter of routine even when, from the local viewpoint, no apparent reason for haste exists.

The historical value of vital statistics is also very great. Complete statistics must be prepared for each calendar year.

Use of vital statistics.

Alone, vital statistics do not necessarily prove anything. The facts thus presented in arithmetical form may or may not comprise all the facts pertaining to the question under consideration—almost invariably they do not. All epidemiological factors which possibly may have a bearing on the question must be taken into consideration.

It is because of positive but unwarranted assertions based on statistics, by persons who fail to observe proper limitations, owing to lack of thorough train-

ing in the statistical method, that uninformed or misinformed persons not infrequently question the value of the statistical method in general, and of any statistics in particular that may be invoked in perfectly logical support of a given contention.

The answer to the old saying, "There are two kinds of lies, ordinary lies and statistics," is, "Figures do not lie, but unfortunately liars do make use of figures."

The idea of comparison always is involved in statistics. The user may not be conscious of this, but everything in the universe is relative to something else, and if any given statistical statement appears to be absolute it is merely because it unconsciously is interpreted and weighed in association with similar information previously acquired. More frequently in practice the attempt frankly is made to compare the statistical information under consideration with other statistical data, and often with information of a different character as well.

Standards of comparison.

In order that any fact or set of statistical facts may be compared honestly with other facts in the realm of vital statistics they all must be expressed in the same ratio to population or group in the population.

The ratio itself does not matter; that is, the rate may be per 100, per 1,000, per 100,000, or per 1,000,000 of population as best suits the purpose. To change a rate per 100 to the equivalent rate per 1,000 is a simple matter of sliding the decimal point over one place to the right. Rates per 1,000 are used for most purposes.

To make satisfactory comparisons we should have available standard rates, "norms," so called. The rate for a whole previous year, or preferably the mean rate for a series of previous years, is used for this purpose. Ordinarily figures should not be used for more than the five-year period immediately preceding. Conditions tend to change, and circumstances may not permit true comparison with figures relating to a more remote period. There are certain exceptions to this rule. For example, it may be desired to show a death rate, by years, for a long period of time.

In studying the rate from a given condition for a season of the year, a certain month for instance, the similar rates for the corresponding month of previous years should be available, although very likely we will compare it also with the average whole-year rate.

As a rule, morbidity and mortality rates are computed for current study by weeks, by months, and by years; occasionally by 5-year or 10-year periods. Exceptionally, as for an epidemic of influenza, morbidity and mortality rates are computed by days in order that a more complete statistical analysis of the outbreak may be made.

Rates for weeks or for months or other short periods of time fluctuate widely. The weekly rate is almost sure to vary a great deal from week to week. Because of this the fairest available whole-year rate always should be borne in mind.

Naturally it follows that the rate for the week or other short-time period must be expressed in terms of an annual rate in order to facilitate comparison. This is done as follows: The number of cases (or deaths) for the week is multiplied by 52 and the rate then computed. This rate is called the *annual rate for the week*. We merely assume that if conditions were exactly the same for the other 51 weeks the whole-year rate would be that figure.

It is our practice to express all rates as annual rates, whether for a week, month, whole year, or longer period. In this way any rate may be compared

directly with standard rates or with rates for any other period of time, shorter or longer, or with regard to season of the year, corresponding or different period.

Population statistics.

It is clear that we must have accurate or nearly accurate population (complement) figures in order to compute approximately correct rates. In civil practice the estimated mid-year population as of July 1 is taken.

In the Navy the daily average complement for the period under consideration is used. This is determined by taking the total number of daily rations issued and commuted during the period (figures obtainable from the supply department). This figure is divided by the number of days in the period and then the number of officers and others not entitled to rations is added.

The larger the complement the smaller the error caused in a rate by incorrect complement figures. In any event the omission or addition of one case (or death) will have more effect on the rate than a considerable variation in the complement.

Annual rates.

An annual rate per thousand is obtained for a definite period of time—a week, month, quarter, or entire year—by multiplying the number of deaths or admissions for the given period by 365 and dividing by the number of days in the period; this figure then is multiplied by 1,000 and divided by the average daily complement. The cases (or deaths) for a week may be multiplied by 52; for a month by 12.

The rate for the entire year, of course, is an annual rate. It is computed simply by multiplying the number of cases (or deaths) which have occurred during the year by 1,000 and dividing by the daily average complement for the whole year.

Provisional rates and final rates.

Morbidity and mortality rates computed from week to week or from month to month must, of necessity, be provisional rates based upon reports for the period in question as received. Final rates ordinarily are not prepared until after the end of the year when final returns have been received. Then the figures may be reviewed and corrections made in weekly or monthly rates by excluding cases (or deaths) which actually did not occur in a given period, and by charging them to the week or month in which they did occur. (In civil practice, in revising death rates, corrections sometimes are made for deaths occurring in the community but chargeable elsewhere.)

Current morbidity and mortality rates are prepared as a matter of routine in order that the incidence, distribution, and severity of disease may be determined for comparison with similar figures for past periods and other communities.

It must be borne in mind that rates for short periods of time—weekly and monthly rates—fluctuate widely because of epidemic conditions, seasonal and other periodic or cyclic influences, and fortuitous circumstances. Such rates always should be compared with similar rates for corresponding periods of past years, although rates for past whole years furnish a guide as to what may be regarded as a normal average, seasonal and other influences, of course, being taken into consideration.

Comparison between one naval station and another, or between ships, and especially between ships and stations, should not be made without taking into consideration a number of conditions which may vary widely—number of per-

sonnel, density of population, overcrowding, housing conditions, permanency and character of the personnel, nature of activities carried on, environment, geographical location, climate, and season.

In the Bureau of Medicine and Surgery provisional annual morbidity rates are computed and plotted on charts each week for the Navy as a whole and for shore stations separately and combined. Separate rates are plotted for the classifications—all causes, diseases only, communicable diseases as a class, venereal diseases as a class, and each of the important communicable diseases. A monthly chart of the venereal-disease rate is kept for every ship in commission and for each shore station.

The general death rate of the Navy for "All causes" and the rate for "Diseases only" are computed every Monday from certificates of death (Form N) received during the preceding week.

Rates other than those expressed in terms of annual rates.

Epidemic rate.—Epidemic morbidity rate. Epidemic mortality rate. Computed simply as the rate per thousand of complement attacked or died as a result of the epidemic, regardless of its length.

Attack rate.—Sometimes used to indicate the incidence of a disease among those presumed or known to have been exposed. Generally expressed as the percentage of cases occurring among contacts. With regard to influenza, it is permissible to conclude that practically everybody in the community has been exposed if the disease is epidemic.

Case fatality rate.—Percentage of fatal cases among persons attacked by a given disease. Computed by multiplying the number of deaths by 100 and dividing by the total number of cases, fatal cases included.

To express this, medical officers frequently use other terms, such as "mortality," "mortality rate," or "death rate." The objection to use of the expression "mortality" is that it is not always clear that the case-fatality rate is meant. The other terms have an entirely different meaning, viz., the ratio of deaths to the population or some group in the population.

Percentage of sick.—This rate expresses the daily average percentage of men on the sick list, for the given cause or causes, during the stated period. It sometimes is called the *noneffective rate*, because when all causes are included it indicates the percentage of complement constantly noneffective during the stated period.

To compute the percentage of sick for a given disease it is necessary to know the number of sick days. This figure divided by the number of days in the period gives the daily average number of patients on the sick list with the given disease. This number is multiplied by 100 and divided by the daily average complement.

This rate is of little value from the standpoint of prevention, but it is of interest from an economic point of view, and thus becomes of interest from the broad standpoint of preventive medicine, as well as general medicine. For the service as a whole the percentage of sick, as calculated at the close of the year upon receipt of final returns, gives definite information as to the percentage of men constantly off duty as a result of disability from any one or all causes.

For example, the percentage of sick, entire Navy, for the calendar year 1917 was 2.18. Suppose a working strength of not less than 500,000 men were required; on the basis of 2.18 per cent constantly noneffective, the total strength must be not less than 510,900.

The percentage of sick for an individual ship or station may be very misleading. It does not give definite information as to the incidence and preva-

lence of disease—for this purpose we must have the numbers of new cases and deaths. A few patients treated on board may lead to a high percentage of sick; on the other hand, the percentage of sick may remain low in spite of a large number of admissions to the sick list if patients are transferred immediately. For example, consider two ships, each having a complement of 1,000 men; each admits to the sick list during the month 10 cases of gonorrhœa (annual admission rate for the month, 120 per thousand), but in one ship all cases are treated on board with the result that 52 sick days chargeable to gonorrhœa occur in that month, resulting in 0.173 per cent of sick due to that disease. In the other ship, let us assume, all cases that are not admitted for record only, with no sick days, are transferred on the day of admission, resulting in no sick days, and consequently zero percentage of sick for the month chargeable to gonorrhœa.

It is obvious that a comparatively high percentage of sick does not, necessarily, constitute a discreditable showing, and that a low percentage does not necessarily indicate a low incidence of disease.

Minimum rate.—The lowest rate in a series of rates.

Maximum rate.—The highest rate in a series of rates.

Median rate.—The rate which stands in a series halfway between the minimum and maximum rates.

The mode (modal rate).—The rate which occurs in the series with the greatest frequency. In some series the mode is not apparent.

The items of a series arranged in order from the minimum to the maximum figure are said to have been placed in *array*.

Mean rate.—The average rate independently computed from the combined basic data included in the series—not the average of the rates.

Example: Communicable diseases, exclusive of influenza and venereal diseases, at the Naval Training Station, Newport, R. I., first quarter of 1920:

Month.	Average daily complement.	Cases.	Annual rate per 1,000.
January.....	2,540	6	30.70
February.....	2,794	23	107.01
March.....	3,267	41	130.52

The mean annual rate for the quarter is 97.65 (obtained as follows: 70 cases multiplied by 4, then by 1,000, and divided by the average daily complement for the quarter, 2,867).

Average of the rates.—In the above example the average of the rates is 89.41. The discrepancy is obvious. In rough calculations it is often sufficient to take the average of a series of rates, but the figure thus obtained must not be regarded as the mean rate. (*See* Weighted and unweighted measures.)

Combined rate.—The average rate for two or more communities combined—not the average of the rates.

Example: Death rate from disease, entire Navy, April, 1920:

	Navy.	Marine Corps.	Entire Navy.
Average daily complement for the month.....	114,543	16,478	131,021
Deaths from disease.....	43	12	55
Annual death rate per 1,000 for the month.....	4.88	9.46	5.45

The combined rate is, therefore, 5.45. Clearly, it would not be proper to take the average of the rates, 7.17, as the death rate of the entire Navy. If that were done, undue weight would be given to the comparatively small complement of the Marine Corps and not enough to the relatively large complement of the rest of the Navy. If the complements were equal the combined rate and the average of the rates would agree. This also would hold for a series embracing more than two items if the complements were all equal.

Other terms used in statistical work.

Series of data.—The items of a series may be either rates or basic statistical data (cases or deaths).

Geographical series.—The items in the series represent ships, stations, or other places.

Historical series.—The items in the series refer to time periods, each series representing a single place.

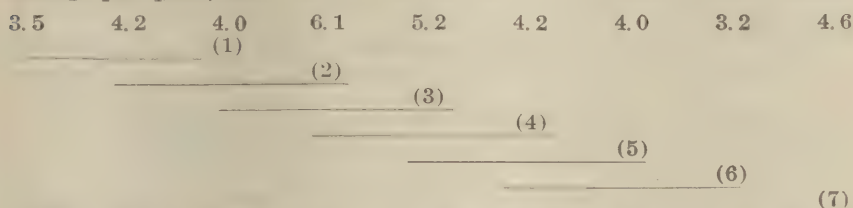
Weighted and unweighted averages.—If the arithmetical averages of two or more series are added together and divided by the number of series the average thus obtained is an unweighted average. It is an average of averages and does not give due weight to differences in complement. Example, an average of the rates instead of a properly computed mean or combined rate as described above.

Likewise, in dealing with cases or deaths directly, care must be exercised not to take an average of averages or the result will not be a properly weighted average; especially should comparison be avoided between unweighted averages for a series of places, or time periods, and a weighted average for another series.

Moving average.—This is calculated as a series of averages moving along, so to speak, through a series of rates. The moving average is most useful where the rates are to be plotted as a curve representing a great many time periods in unbroken sequence, especially when there is reason to believe that the fluctuations observed in the individual rates are largely due to periodic or cyclic influences. Suppose we have the death rate by years for a given place plotted on a chart as a curve extending over a long period. There will be fluctuations from year to year, of course. If a curve for successive five-year averages instead of by single years is plotted, the fluctuations will be smoothed out to a considerable extent, but the effect of unusually high or low rates will be merged in each separate five-year average and the tendency will be to conceal any periodic effect on the rate that is due to cyclic phenomena which periodically recur, such as epidemics of influenza, measles, unusually bad winters, etc.

A curve can be plotted from *moving averages* that will smooth out fluctuating rates and yet preserve in the comparatively smooth curve the influence of regularly recurring fluctuations. This is best explained by an example. Suppose we had the following series of rates: 3.5, 4.2, 4.0, 6.1, 5.2, 4.2, 4.0, 3.2, 4.6, 4.2, and perhaps a longer series. To plot a moving average curve on a 3-year pivot (3-year moving average) we would proceed as follows: The average for the first three rates, 3.5, 4.2, 4.0, is taken and plotted under the 4.0 rate as the first moving average plot point. The next moving average point is obtained from the rates, 4.2, 4.0, 6.1; the next from 4.0, 6.1, 5.2, and so on, dropping a rate and taking up the next in the series for each new moving average point. The following diagram illustrates this. The figures in pa-

rentheses refer to the position on the chart of the first, second, third moving average plot point, etc.:



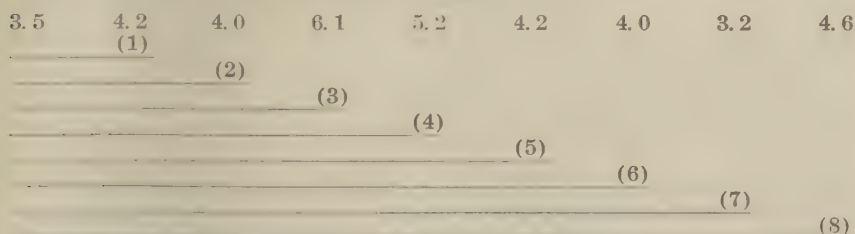
The moving average period may be taken as 5 years, 7 years, 10 years, or other pivot number. The closer the period chosen approximates the periodicity of recurring phenomena the better their influence will be brought out. It sometimes is desirable to try two or three moving average periods to see which works out best.

The question sometimes arises as to whether the first moving average plot point should be set back. For instance, in a long series of monthly rates the moving average is to be calculated on moving average periods of 12 months; strictly speaking, the first moving average plot point falls on the date of the twelfth month, but it is usually permissible to antedate it to the sixth month, in which case half of the data from which it is calculated lies before and half behind it.

Progressive average.—This is a simple matter of plotting under each new rate in the series the average of all preceding rates from the beginning of the series.

Suppose we are charting the death rate of the Navy by weeks from the first of the year. The rates fluctuate from week to week. The progressive average curve shows, each week, the average annual rate from the first of the year to date. Inasmuch as all rates are expressed as annual rates, the progressive average for the last week of the year actually is the annual rate for the year, subject of course to revision upon receipt of final returns.

Of course, the correct procedure is to compute the mean rate for each new progressive average point, but for ordinary purposes the average of the preceding rates is sufficiently accurate to show the trend of the curve, which is frequently so obscured by fluctuations that it can not be perceived without a progressive average curve, plotted along with the fluctuating curve. The following diagram shows the scheme. The figures in parentheses indicate the positions on the chart of the progressive average plot points.





Compilation of statistical data.

On board ship, or at a naval station, compilation is ordinarily a simple matter of counting up the total number of admissions to the sick list, or the number of admissions on account of certain diseases, deaths, and number of sick days. The daily average complement must be determined in order that rates may be computed.

Where thousands of reports must be handled, as in the bureau, card-punching machines, sorting machines, adding machines, and machines for calculating rates are used.

Where a great many reports must be handled without machines, recourse to hand tally sheets must be had. The cross 5 method usually is employed;

i. e., . The cross 10-dot method sometimes is used: .

Sheets of paper are ruled in accordance with the different combination of data to be tallied from the individual reports.

From the figures thus obtained rates may be computed, and these may be presented for study on graphic charts in the form of curves plotted to scale, or as bars plotted or drawn to scale.

Before statistical data can be compiled they must be definitely classified, both with regard to the complement and type of disease. The complement is classified in accordance with the established ranks and ratings of the Navy, and composite groups such as recruits, fireroom force, deck force, officers, enlisted men, age groups, force ashore, force afloat, etc.

To make accurate classification of diseases possible, medical officers are required strictly to follow the Navy Nomenclature and Classification of Diseases, Injuries, and Poisons. This is divided into two parts: (a) The nomenclature, which is merely an alphabetical list of the acceptable names of diseases, and (b) classification. This is a composite classification based in part upon anatomical considerations, but in so far as the important communicable diseases are concerned, upon modes of transmission which have a more or less direct bearing on measures for their prevention and control. Therefore, when the medical officer is in doubt as to which of two diagnostic terms he should select, reference should be made to the classification table in order that the title selected will place the case in its proper class. Care must be used to select the title which actually fits the case. For example, the title, "cerebrospinal fever" is to be used when, in the judgment of the medical officer, the disease is probably meningococcus meningitis, even though meningococci have not been recovered by lumbar puncture or by nasopharyngeal swab. The term meningitis cerebrospinal means some other form of acute cerebrospinal meningitis-pneumococcus, streptococcus, etc., other than tuberculous meningitis.

Deaths are classified in the bureau in accordance with the International List of the Causes of Death.

For routine statistical study disabilities and deaths are classed broadly as follows:

1. All causes.
2. Diseases only.
3. Accidents and injuries, including poisons.
4. Accidents and injuries.
5. Drowning.
6. Communicable diseases exclusive of venereal diseases, influenza, tonsillitis, and minor infections of the respiratory tract.
7. Each of the more important communicable diseases separately: Cerebrospinal fever, chicken pox, diphtheria, influenza, malaria, measles, mumps, pneumonia-primary broncho, pneumonia lobar, scarlet fever, smallpox, tuberculosis (all forms).
8. Venereal diseases as a class.
9. Gonococcus infection, syphilis, and chancroidal infection, separately.

The figures for any special grouping of diseases can be obtained quickly in the bureau by means of sorting machines. The groups mentioned above are used as a matter of routine, and rates also are computed weekly for each of the 26 classes of the Navy nomenclature classification.

Summary of rates used in presenting morbidity and mortality statistics:

Morbidity rates:

General morbidity rates (rates expressed in terms of the whole complement without regard to sex, age, race, or occupational group).	{ For all causes. For a given disease. For a class of diseases.
Specific morbidity rates (rates for specified groups or classes in the complement, as age group, race, or occupational group).	{ For all causes. For a given disease. For a class of diseases.

Mortality rates:

General death rates (rates expressed in terms of the whole complement without regard to sex, age, race, or occupational group).	{ For all causes (this is the crude death rate). For a given disease. For a class of diseases.
Specific death rates (rates for specified groups or classes in the complement, as age group, race or occupational group).	{ For all causes. For a given disease. For a class of diseases.

Interpretation of vital statistics.

It is the main purpose of vital statistics to establish relationship between different facts relating to sickness and death. Such relationship is termed correlation. The underlying purpose, of course, is to determine cause and effect. This brings us at once into the domain of logic.

Cause of an event.—The circumstances which *must* have preceded in order that the event should happen (Jevons; *Lessons in Logic*). An event seldom has a single cause. *Statistics do not in themselves establish cause.* However, the first step is to prove the existence of correlation, and this may be accomplished by the statistical method.

Correlation.—Correlation may be simple or complex.

Primary or simple correlation (direct comparison).—Two series of data only are compared. Example: Death rates from pneumonia set forth by months, to determine correlation between pneumonia mortality and season of the year.

From the statistical standpoint epidemiological data are known as variables. In any given problem one of the variables always is used to interpret or measure the other data. This one is termed the *independent variable*. In the above example the death rates are measured by months; months, therefore, constitute the independent variable.

Almost without exception, when time periods constitute one of the variables, it is the independent variable. The same is true of classifications such as sex, age groups, races, occupational groups, etc.

The data to be measured are termed *dependent variables*. Numbers of cases, deaths, morbidity and mortality rates, percentage of all sorts of things, bacterial counts, gallons, cubic feet of water, and similar data expressed in varying or fluctuating numbers naturally constitute dependent variables.

On a chart the horizontal scale always should be used to show the independent variable and the fluctuating dependent variable should be plotted to the vertical scale (the numerical scale).

When correlation is established definitely between *two* series of data a casual relationship is demonstrated thereby *provided connection between the variables also can be established*. Connection is not shown by statistics alone. *Causal relationship does not necessarily mean the only cause.*

Secondary or indirect correlation.—Three or more series of data are compared; data not obtainable in comparable form for direct comparison. The processes of logic are more complicated in such instances, and the liability to arrive at an erroneous conclusion is greater.

We must bear in mind the mathematical proposition that two things which equal a third are equal to each other, but it also must be remembered in statistical work that *two series of data which vary closely with a third may not bear a causal relation, or, indeed, any relation whatever to each other.*

Example involving secondary correlation.—An epidemic of cerebrospinal fever at the Naval Training Station, Great Lakes, Ill., epidemiological factors:

Number, frequency, and distribution of the cases.

Number and distribution of carriers.

Length of service of those attacked.

Housing conditions.

Month of the year and weather conditions.

Personal hygiene of those attacked.

Fatigue, worry, and exposure to other predisposing influences.

Prevalence of other diseases.

It is only by establishing direct and indirect correlation between the incidence of the disease and these factors (and any other factors which seem to have a bearing) that the whole truth about the outbreak can be determined.

Experience during the war showed that there was low correlation between cases and carriers but that a high degree of correlation existed between the incidence of the disease and certain combinations of the other factors which in turn were closely correlated with each other.

Methods of demonstrating correlation.—(a) By graphic charts, comparison of curves or bars. (b) By mathematical formulæ involving the use of coefficients.

Demonstration of cause or causal relationship.—1. The *synthetic method of proof*, by which known particular facts are pieced together in order to reach a more general conclusion. This is the inductive method of reasoning.

There must be agreement between the facts which are to be accumulated. It is, therefore, sometimes called the method of agreement. The following rules are applicable to the synthetic method of proof:

(a) Rule of agreement: If certain instances of the phenomenon in question have only one circumstance in common, that circumstance is the cause of the phenomenon (or the effect, depending upon the proposition).

(b) Rule of difference: When the phenomenon in question occurs in one instance and is absent in another, and one circumstance only is missing in the latter instance, all other circumstances being in agreement, then that one circumstance is the cause or an inseparable part of the cause of the phenomenon (or effect, depending upon the nature of the proposition).

(c) Rule of combined agreement and difference: When the phenomenon in question occurs in two or more instances and is absent in other instances, if there is one circumstance common to all instances in which the phenomenon does occur, and all instances in which the phenomenon is absent have nothing in common but the absence of that circumstance, then that circumstance is the cause or an inseparable part of the cause of the phenomenon (or effect, depending upon the nature of the proposition).

In the synthetic method a few instances are not sufficient to establish proof. The larger the series the stronger the proof.

2. *The analytic method of proof.*—Deductive reasoning by which a proposition is asserted to be true after which the proof is sought in correct premises, and so on from one proposition to another until a known truth is reached and the main proposition proved. In other words, the mind looks ahead to the conclusion and then seeks to justify that conclusion by establishing correct premises for its logical proof. This method must be resorted to when it is not clear how to start the ordinary inductive method.

3. *The indirect method of proof.*—Logical process of *reductio ad absurdum*.

Fallacies and pitfalls.—There is always danger of unfair comparison of morbidity and mortality statistics for different places when consideration is not given to—

1. Comparative reliability of the basic data.

2. The accuracy with which the data for each place were compiled and the methods of computing rates.

3. Epidemiological influences—comparative effect of potent factors.

4. The danger of concealed classification.

There is always danger that statistical data which purport to convey certain definite information may be concealing classes such as sex, age, race, color, or particular occupation, which, if revealed, might cause a very different interpretation to be placed on the figures. For example, if we compare the incidence rates of pulmonary tuberculosis among employees in two different industries a conclusion that one may be more conducive to the development of the disease than the other may be fallacious, because the figures may conceal the fact that the majority of employees in one are very young, while in the other they are mostly persons beyond middle age. In the same way nationality or race may be concealed. Negroes in the United States have a high death rate from tuberculosis irrespective of occupation.

The following example illustrates the necessity for constant guard against the introduction of concealed facts. A very extensive experiment to determine the possible prophylactic value of pneumococcus vaccine was conducted in a series of large institutions, by vaccinating every other newcomer, leaving each alternate one as a control. Now, some of these upon arrival were in good physical condition; others not. In cases of choice it practically worked out that an undue proportion of those who were not well to start with fell into the group of controls. For the first few months the death rate from pneumonia was much lower among those vaccinated. The figures concealed the fact that a higher proportion of those unvaccinated probably would have contracted and succumbed to pneumonia under any circumstances.

REFERENCES.

- Preventive Medicine and Hygiene.—Roseneau.
 Preventive Medicine and Hygiene.—Park.
 Practical Preventive Medicine.—Boyd.
 Principles of Hygiene.—Bergey.
 Naval Hygiene.—Gatewood.
 Naval Hygiene.—Pryor.

Field Sanitation.¹

The activities of a medicomilitary organization tend to concentrate toward one primary objective, "*The conservation of physical efficiency for combat.*" The hospital corpsmen of the Navy serve ashore, as well as afloat, and in addition to their duties pertaining to naval warfare must be prepared to serve as members of the medical department of a naval landing party or a Marine Corps expeditionary force; and, as such, require a knowledge of field conditions.

One of the prime requisites for victory is health. In order to fight, an army literally and figuratively has to "*take the field.*" Consequently *field hygiene and sanitation* is one of the most important subjects for military sanitarians, as at this time the laws of preventive medicine are made applicable to war, and

¹ Prepared by Lieut. Commander W. L. Mann, Medical Corps, United States Navy.

this adaptability to war-time conditions is the supreme test of all military efficiency.

The functions of a medicomilitary organization may be divided roughly into (a) prevention of disease, and (b) treatment of disease. Prevention is of such vast importance to the military personnel that this function only will be considered in this discussion. The measures undertaken for the prevention of disease probably have saved many more lives than curative medicine, thus emphasizing the old adage "An ounce of prevention is worth a pound of cure."

Concisely expressed, the major portion of field sanitation may be outlined under the following topics:

1. Food and water.
2. Conservancy (proper waste disposal).
3. Insect control.
4. The hygiene of the march.

FOOD AND WATER.

Food.

In the field a large percentage of the rations is issued in tin containers, the contents of which, due to improper preparation, exposure to excessive heat, and lack of care in handling, frequently undergo decomposition and become especially dangerous to health if their use is permitted. Therefore a careful inspection of all canned goods should be required. The terms "springers" and "swells" are applied to bulged, blown, or swollen cans, which, when pressure is made on the ends, give a crackling sound. "Springers" are caused by overloading the cans, and, while not desirable, the contents are suitable for use. "Swells" are caused by the formation of gas due to decomposition and may be differentiated from "springers" by a splashing sound when the can is shaken and a hollow note when gently tapped. These should be condemned as unfit for use.

Occasionally the inside of a can may present a blackened appearance (so-called can burn). This condition is not due to putrefaction, but is caused by the precipitation of stannous sulphide in an acid medium. Formerly, a can with two solder holes was indicative of a "swell" which had been punctured to let out the gas and then resoldered, but now many manufacturing firms use two solder holes in sealing their cans. It is well to reject cans with three solder holes.

Water.

Water constitutes 60 per cent of the body weight, or the equivalent of 10 gallons in the average man's body. The loss of 1 gallon of this body water has serious consequences, and if $1\frac{1}{2}$ gallons are lost the result is fatal. It is estimated that 1 quart of water is sufficient for about $7\frac{1}{2}$ miles of marching under ordinary climatic conditions.

Daily allowance.—The average water allowance in camp is as follows: Two gallons per man and 10 gallons per horse. The minimum per man is one-half gallon for drinking and one-half gallon for cooking purposes. Six gallons is the minimum for a horse.

Source.—The sources of water are (a) rain water; (b) surface water, such as lakes, ponds, etc.; and (c) underground, which includes wells, springs, etc. All these vary in degree as to purity and potability. Rain water is usually the most satisfactory of any of the natural waters. Large bodies of water—for example, large lakes—are, because of the greater dilution of contaminating material, more likely to contain satisfactory water than smaller ones. One

should be suspicious of all surface water. The appearance of water is no index of its purity, and all water must be considered as contaminated until tests prove it otherwise. Wells are of two varieties, deep or shallow. Water taken from shallow wells is always questionable, while that from deep wells or deep springs is usually suitable for human consumption. If water is used from a running stream, it should be taken at a point where there is considerable depth and a strong current, and always "upstream," or, in other words, above the camp site. Provisions for watering horses should be made below the site chosen from which to obtain drinking water, and for washing clothes, still farther downstream.

Storage, collection, and distribution.—Water receptacles should be kept well covered, and as the ground in close proximity to them is likely to become muddy, it is advisable to build a sand or gravel pit 2 feet square and 1 foot deep to absorb the waste. The receptacles should be cleaned daily with boiling water, or, still better, rinsed with a solution of one-third of a teaspoonful of potassium permanganate to 1 gallon of water, or with a 1-1,000 solution of chlorinated lime. These are harmless and more certain in their action than boiling water when used alone.

Canteens when not in use should be emptied and dried and should be frequently washed with the above solution. Weak tea, highly recommended for use in the canteens, should be boiling hot when poured in, thus insuring sterility of the canteen as well as the contents. Drinking cups should not be used in common by several individuals. Should conditions arise which make it absolutely necessary to use common drinking cups, a certain degree of safety may be insured by keeping the cups when not in use immersed in a 1 per cent solution of formalin.

Purification.—Boiling the water for 10 minutes is the simplest method of purification. Should the water be turbid, it may be clarified by the addition of 6 grains of alum to the gallon, stirring well and allowing the sediment to settle.

Chlorination of water is extensively practiced to-day. Calcium hypochlorite (bleaching powder), the agent used, is on the supply table under the caption Calx chlorinata, U. S. P. A simple formula for its use is as follows: Dissolve one-half teaspoonful of chlorinated lime, taken from a freshly opened container, in 1 pint of water, and label this "stock solution." This solution deteriorates rapidly and a fresh solution should be prepared every four days. One-half teaspoonful of this stock solution added to each gallon of water, stirred well and allowed to settle for 20 minutes, will insure the destruction of all bacteria. These measures approximate the quantities given in the chapter on Preventive Medicine, Hygiene, and Sanitation.

See paragraph 2666, Manual of the Medical Department, U. S. Navy, 1922, for instructions regarding the use of the Lyster bag.

CONSERVANCY OR THE DISPOSAL OF WASTE.

Waste may be divided as follows:

1. Refuse—(a) Garbage; (b) Rubbish (boxes, paper, etc.).
2. Excreta—(a) Night soil (urine and feces); (b) Manure.

Collection of waste.—Metal garbage cans, if available (wooden or cardboard boxes may be substituted), should be placed at intervals in the company streets for the deposit of and collection of waste paper, burnt matches, fruit peelings, cigarette stumps, etc. This accomplishes primary cleanliness of the camp and inculcates the habit of tidiness in the men.

Garbage cans should be well covered and placed on raised platforms at least 2 feet above the ground. The soil beneath these platforms easily is contaminated by the overflow or drippings and requires careful supervision to prevent pollution and fly breeding. The surface should be scraped or raked daily and shoveled into the garbage can, fresh dry earth being then spread over the scraped area. The promiscuous use of lime to cover over filth is not recommended.

The ultimate disposal of waste.—The final disposal of waste ultimately is confined to two procedures, viz., burning or burial. In camps of a few days'



FIG. 155.—Garbage incinerator or crematory. (Mason.)

occupation, an ordinary pit will suffice as a means of disposal of liquid and solid waste. The pits for the kitchen refuse should be located near the place where the men wash their mess kits. After scraping the refuse food into this pit, each man immerses his mess kit and other utensils into a can of *soapy water*, which is boiling over a fire. Then after this washing, the mess kits and other utensils should be rinsed in a similar can of boiling clear water. It



FIG. 156.—The Army "Leavenworth" type pit incinerator, built one-half scale.

will be found that no wiping of the mess kits is required, as they will dry almost immediately.

Field sanitary devices.—The following points should be kept in mind: (a) Field sanitary devices, such as latrines, urinals, incinerators (Figs. 155, 156), etc., are simple in character, and are comparatively easy to construct; constant attention and supervision is necessary to maintain field sanitary devices in such condition that there will be no weak link in the chain of sanitation.

Latrine frontage.—In determining the total length of latrine pits necessary for an organization, multiply the number of men by one-tenth and the result will be the expression in yards of the total length of latrines required, except

in commands of less than 400 men, when a multiple of one-seventh should be used. For example, a regiment of 940 men will require 94 yards of latrine frontage, while a battalion of 280 men will need 40 yards ($280 \times \frac{1}{7} = 40$).

Location and care of latrines.—The latrines should be located at a distance of at least 50 yards from the camps and as widely separated from the kitchens



FIG. 157.—A row of latrines and urinals.

as possible. In open latrines each man is required to cover his excreta with fresh earth. Each morning the pits may be burned out with straw and crude oil. When latrines are boxed over, as in the "Harvard knockdown box," the inside of the pit and box should be thoroughly blackened, using 1 pound of



FIG. 158.—The "Lucas" and "Back to Back" modification of straddle trenches.

bone black to 3 gallons of crude oil. This method acts as a deterrent to flies, as they tend to avoid blackened surfaces.

Types of latrines.—The type most easily constructed is the straddle trench, known as the 1-2-3 latrine, the dimensions of which are easily remembered, viz., 1 foot wide, 2 feet deep, and 3 feet long. (Fig. 157.) These are highly recommended because of the slight possibility of the sides being soiled with

urine or faeces. They may be boxed over with seats arranged back to back or constructed according to the Lucas modification. (Fig. 158.)

An important point to remember is that the bacteria which disintegrate the urine and faeces are found in the upper few inches of the soil, and for this reason these superficial latrines permit a more rapid sterilization of the dejecta than the deep trenches.

During the halt shallow ditches may be dug with a stick, trench shovel, or the bayonet. In a camp of a few days' duration, the straddle trenches will suffice. For camps of longer occupation, deep latrines, boxed over with the Harvard latrine box, are recommended.

All trench latrines, when they become filled to within half a foot of the surface, should be well covered over with earth and labeled with an "L." This

serves to inform future occupants regarding the location of abandoned latrines. In camps, not of a permanent nature or when troops are constantly on the move, burial is the most convenient and the only rapid means of waste disposal and is practiced universally in our modern armies. Incineration has the advantage of a complete destruction of all waste and is the better method from a sanitary viewpoint.

Specifications of incinerators.—

The Caldwell type is the name applied to two trenches dug at right angles to each other, intersecting in the center. (Fig. 159.) The dimensions are: Length, 6 feet; width, 1 foot; depth at the center, 1 foot. There is a gradual slope upward from the center to the surface at either end. A chimney is improvised at the center by using a barrel and covering its sides with clay; scrap iron can be utilized for building a grate, and stones for lining the sides of the trenches. A strong fire is started at the bottom of the chimney, and the draft is regulated by closing the trench openings which are out of line with the wind.



FIG. 159.—Caldwell incinerator.

Solid garbage is burned by throwing it down the chimney, while the liquid refuse is evaporated by pouring it on the hot stones.

Disposal of liquid waste.—Dishwater, bath water, and other waste water should be drained into "soakage pits." Grease and soap soon clog the pit, unless some provision is made for them. This clogging is combated by the use of traps. (Fig. 160.)

A urinal soakage pit is constructed as follows: Dig a pit 4 feet square and 4 feet deep, fill up to within 6 inches of the surface with large stones or empty perforated tin cans, and insert four pieces of iron piping $4\frac{1}{2}$ feet long, one at each corner. Tin funnels are fitted and inserted into the ends of the iron pipes. This style is used extensively abroad. (Fig. 162.)

Horse litter may be used as fertilizer or may be burned. It is used as fertilizer by (a) distribution, which method is applicable only in warm, sunny weather, the manure being spread on hard, level ground, care being taken to have it spread in a thin layer, and to have it raked over a few hours later and all small lumps broken up, thus permitting rapid drying and preventing fly

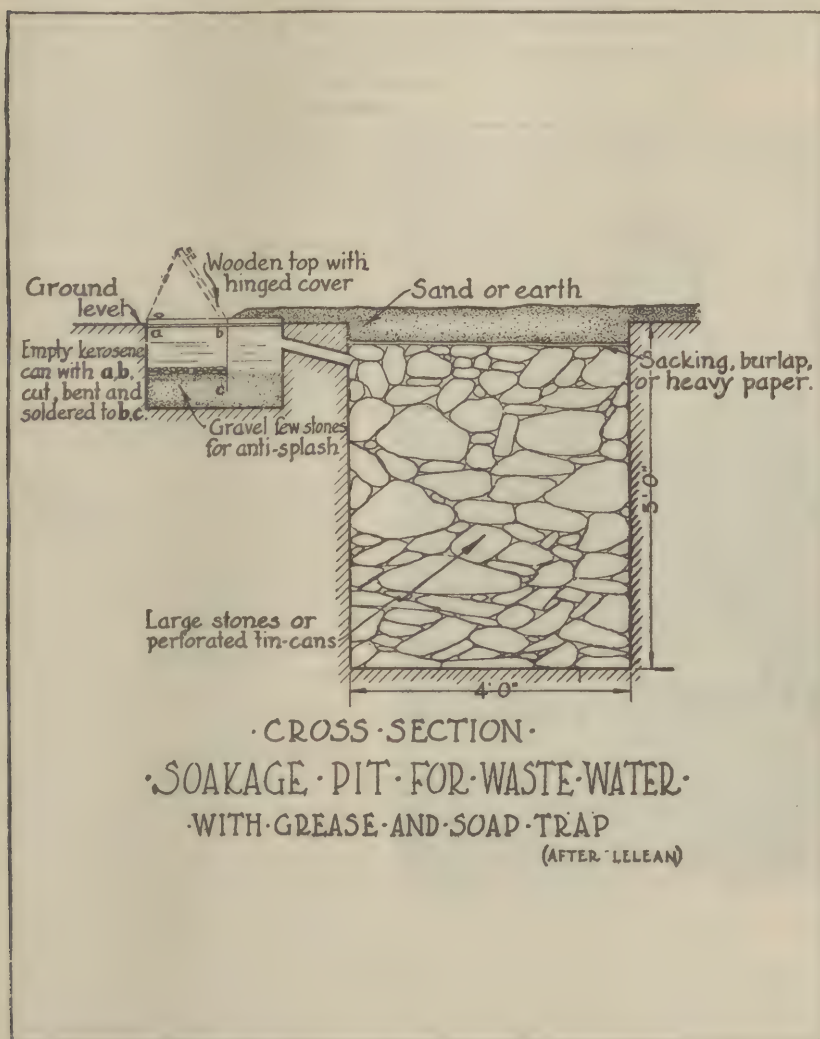


Fig. 160.—(From "Sanitation in War," by Lelean.)

breeding: (b) close packing (biothermic method), by which method the manure is moistened with water and closely packed by gradually adding new manure and beating the pile with shovels, the center of the pile undergoing fermentation, and a temperature of more than 150° F. generated, which is sufficient to destroy the eggs and larvæ of flies under the surface of the pile; (c) larval flytrap, in which the manure is stored on an elevated platform composed of parallel slats, underneath which is placed a receptacle containing water or

some insecticide solution. The pile being exposed encourages flies to lay their eggs, which are hatched into maggots that burrow through the pile in search of earth, with the result that they fall between the slats into the solution below, where they are destroyed; (d) chemicals, three-fourths pound of borax to each 10 cubic feet of manure sifted on fresh manure and then sprinkled with water will prevent the fly eggs from hatching.

A wire hammock slung between two trees may be improvised as a manure incinerator. The requisites are an amount of heavy wire, a pair of wire clip-

pers, and a little ingenuity. The manure is thrown on the hammock and burned. The hammock can be swung with a pendulum-like motion in order to increase the draft, which will facilitate the destruction of the litter. This method proved very successful at the Marine Barracks, Quantico, Va. Another method is to place the manure in piles 2 by 2 feet, known as windrows, sprinkle them with oil, and burn.

INSECT CONTROL.

Flies.—Flies breed in manure, human excreta, and decaying organic matter. (See methods of disposal of manure.) The picket line should be burned over weekly, using crude oil and straw for this purpose.

All galleys should be securely screened and all food should be kept in screened receptacles. Mosquito netting may be utilized to make fly-proof cages in which to place the food after it has been prepared. The presence of a large number of flies almost always indicates that *food* or *filth*, or *both*, is *present somewhere in the vicinity*.

Traps and swatters should be used freely. In daytime flies tend



FIG. 161.—Improvised field shower bath, soakage pit, and soap trap for waste water.

to settle on broad surfaces, but at night they prefer hanging cords, wires, etc. Flies are attracted by the sunlight except on a very warm day, when they seek the shade. Liquids containing poison may be used to kill flies, for example: One per cent sodium salicylate or one-half of 1 per cent formaldehyde solution ($2\frac{1}{2}$ per cent solution of formalin) in milk, also a solution of sodium arsenite. The fumes of gasoline are fatal to flies. Put the gasoline in a saucer or a can, and pass the same under the flies resting on the ceiling, horizontal wires, and other places.

Sticky fly-paper may be made by heating castor oil, five parts by weight, and powdered resin, eight parts, until the resin is dissolved. Do not boil. The solution is applied while hot to glazed paper.

Mosquitoes.—In draining an area containing mosquito-breeding places make the drains as few as possible, clean cut, with sloping edges, narrow bottoms, and straight courses. If necessary, laterals may be run into the central ditch, i. e., "fishbone" drainage. Laterals should join the main ditch at an acute angle in order to lessen the deposit of silt and débris. Frequent inspection and constant repair are necessary for the proper maintenance of the ditches.

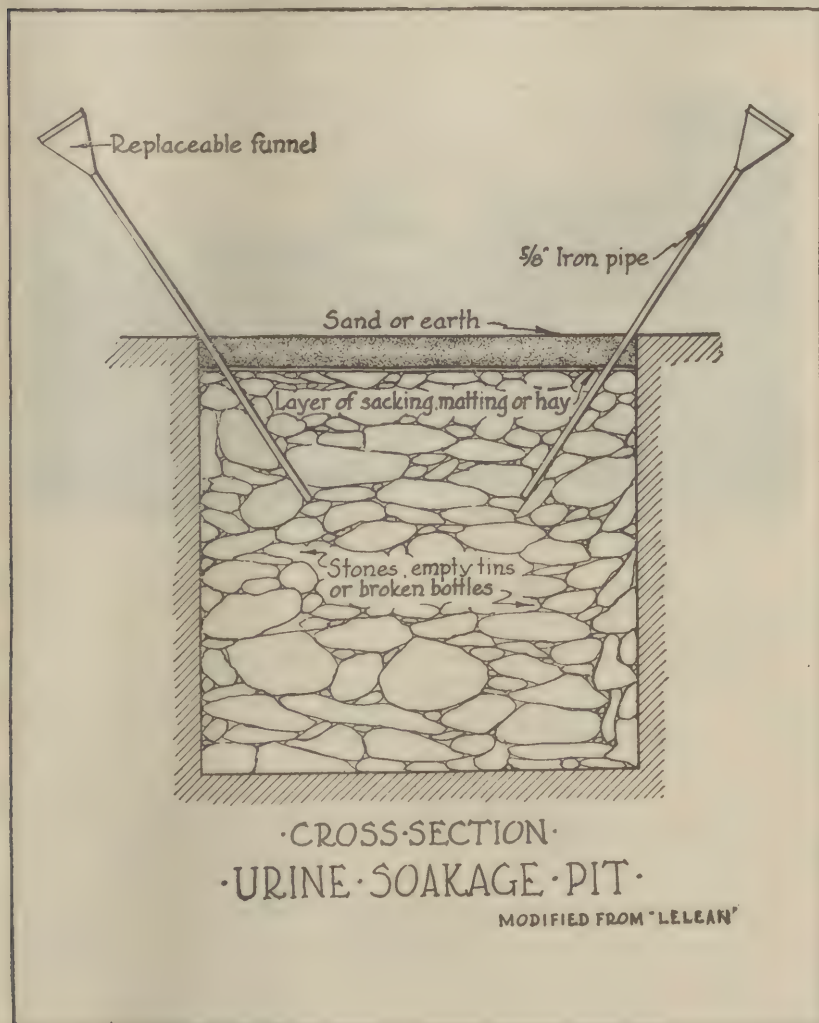


FIG. 162.—(From "Sanitation in War," by Lelean.)

When it is impossible to drain certain mosquito-breeding areas they may be controlled by oiling, using crude petroleum, about one-half ounce for every 15 square feet. The oil forms a thin layer on the surface of the water, and when the mosquito larva, commonly called a wiggletail, comes to the surface the oil clogs up the breathing apparatus and kills the larva by asphyxiation. A larvicide which usually contains carbolic acid has been successfully used in Panama.

Kerosene is used extensively in some tropical countries as a repellant to mosquitoes. Spirits of camphor and oil of pennyroyal will keep away mosquitoes, but their action is not lasting, and a single application will not suffice through the night. One part of oil of citronella and four parts of vaseline is highly recommended.

A satisfactory culicide consists of equal parts (by weight) of carbolic acid crystals and gum camphor. The acid is slowly melted and then gradually poured over the camphor, forming a clear volatile liquid. Volatilize 3 ounces of the mixture for every 1,000 cubic feet of space. Sulphur, 2 pounds per 1,000



FIG. 163.—Modified urinal soakage pit with replaceable screened tin funnels.

cubic feet, is also used. Remedies for mosquito bites include soap, alcohol, ammonia, and glycerin.

Division of common insects.

Common name.	Species or genera.	Common diseases transmitted.	Breeding places.	Life history.	Range of flight.
Flies.....	{ Musca..... domestica.	{ Typhoid; cholera; dysentery; diarrhoea; small-pox; erysipelas.	Manure; garbage; decaying matter.	Eggs hatch out in 12 to 24 hours into larvæ. Larvæ grow rapidly and in four to six days become pupæ (resting stage). In two to four days mature to adults.	Several miles.
	{ Anopheles.	Malarial fever.	Rural; stagnant pools; among grass and rushes; swamps and marshes.	Ova deposited in mass of 250 eggs; in two to four days, hatched into larvæ and in a week reach pupa or wingless resting stage. In two or three days develop wings and become adult mosquitoes.	One-half mile, usually against the wind.
Mosquitoes..	Stegomyia.	Yellow fever..	Domestic; develop in water in any container near a house or in gutters, cisterns, spouts, etc.	Female lays 70 eggs. Larvæ hatch out in two days and develop into pupæ in one week. Then in two or three days become mature adults.	Maximum of 75 feet; usually hide in nooks away from wind.
Lice.....	Pediculus..	Typhus fever; relapsing fever.	Breed and spend their entire life on warm-blooded animals, including man.	Eggs cling to hair or clothing of host (man). They hatch out in three to four days and mature in 10 to 15 days.	Do not travel much; keep close to one host.

Lice.—Body lice are concerned in the transmission of *typhus fever*. Various methods are employed in attempts at the eradication of this parasite. The clothes may be immersed in gasoline or kerosene. N. C. I. powder consists of 96 per cent naphthalene and 2 per cent each of creosote and iodoform. This powder is dusted in the interior of the clothes.

Steam heat kills both the adult lice and the eggs. The Serbian barrel makes a simple and efficient means of sterilizing the clothes. It will be profit-

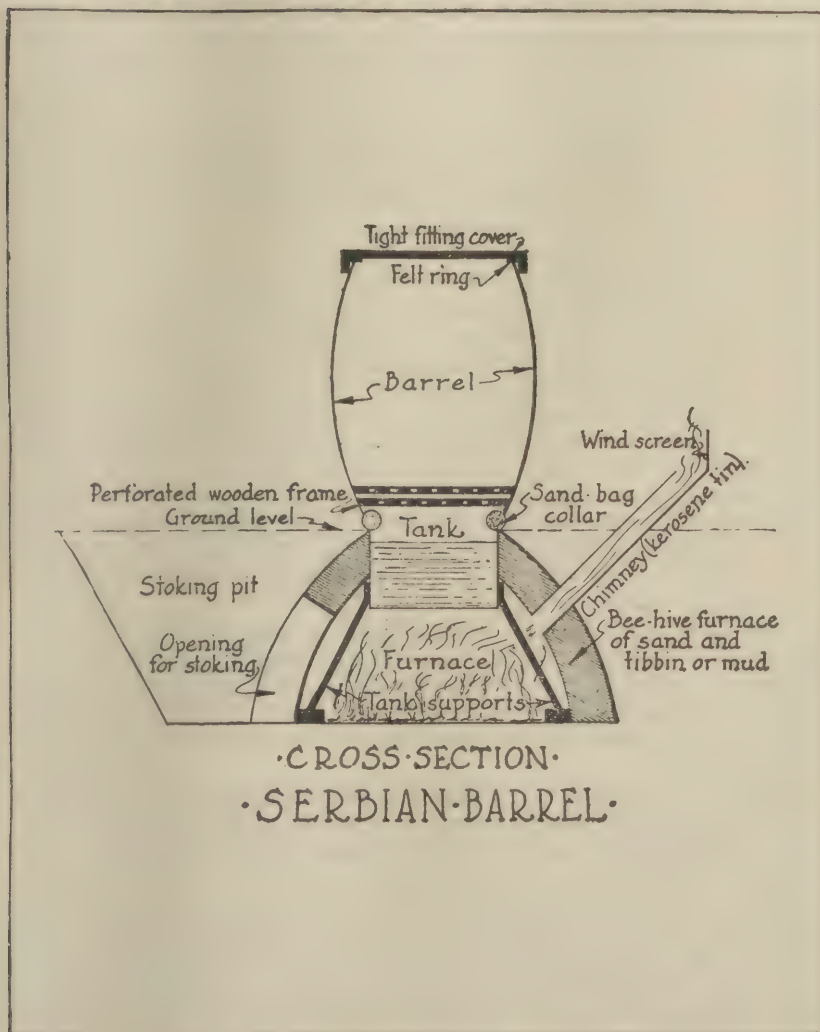


FIG. 164.—(From "Sanitation in War," by Lelean.)

able to study this device in the accompanying sketch, as it is made easily and is a very useful means of sterilization. (Fig. 164.)

THE MARCH.

Marching is usually a military necessity executed to bring troops into advantageous or strategic positions at or near the battle line. It is therefore necessary to take well-known precautions in order that the men may arrive at their

destination in the best physical condition and not completely fatigued. The starting hour, of course, is determined by the existing necessities. However, whenever possible it should be in the early morning when the men are fresh and active and the air is cool and stimulating. The greater portion of the march therefore is accomplished before the heat of the day becomes intense. Night marching should be practiced only when military necessity demands, because the depressing physical effects usually outweigh the advantage of strategic positions. Unless unavoidable, strenuous marching during the heat of the day should not be attempted.

Previous to the start a meal of bread, cereals, milk, tea, or coffee should be allowed. Marching with empty stomachs is weakening and therefore detrimental.

The length of the march for a division or a brigade under normal conditions should not exceed 12 or 15 miles daily. The length of a day's march, however, is not measured by miles, but according to the condition of the roads, the weather, the pace, the loads carried, etc.

The rate of the march should not average more than $2\frac{1}{2}$ miles per hour, inclusive of stops; more than this will lead to fatigue and exhaustion. To average this, one hundred and twenty 30-inch steps a minute are required. The march should be at route step, in open ranks, half on each side of the road. This decreases the heavy, devitalizing cloud of dust, foul odors, water vapor from perspiration, etc., which tends to hang over close-order ranks. The march should end with the same equal pace with which it started; the frequent "final spurt" should not be invoked, as at this stage it is doubly depressing. The men should alternate between marching in step and at ease; singing and whistling popular tunes is to be encouraged. This distracts their minds from their fatigued condition, and is probably the surest way of preventing early exhaustion. Straggling, either from poor discipline or fatigue, is always to be avoided, as it is depressing to the "morale" of the entire body of troops.

In hot weather coats should be unbuttoned or removed on the march, but replaced at halts. The body should be inclined slightly forward, similar to the position assumed in mounting a flight of stairs. This is especially to be advised if the soldier is carrying his full equipment. Marching rigidly erect necessitates the expenditure of a great muscular effort and therefore produces early fatigue.

Smoking on the march has a depressing effect on the physical condition of the men, particularly upon the heart and lungs. It also has a tendency to cause the mouth to become dry, creating excessive thirst. This practice should be strictly prohibited.

Before the start, only the average amount of water to a meal should be ingested and the water bottles filled with water, unsweetened tea, or coffee. Following this, the canteens should not be resorted to until $7\frac{1}{2}$ miles have been covered. The contents then should take the men to the end of the 15-mile march. The average normal requirements are 1 quart of water at the end of every $7\frac{1}{2}$ miles.

The wise old soldier will march nearly all day with only an occasional recourse to his water bottle and then very sparingly. The young and unwise soldier will drink excessively every few miles, and as a consequence becomes "waterlogged," perspires freely, tires easily, and refills his bottle from every strange, perhaps heavily contaminated, stream along the wayside. Water bottles should not be filled from the strange sources until the quality of the water is approved by the medical officer.

A fairly satisfactory method of allaying the thirst while on the march is to suck on a small pebble placed in the mouth, to excite the flow of saliva, at the same time breathing through the nose.

At the end of the first 10 minutes, a short halt of a few minutes is advised to enable the compensatory activities of the heart and respiratory organs to adjust themselves to the march, or, in other words, to gain "the second wind." Subsequent halts of 5 or 10 minutes are ordered at the end of each hour and halts of 30 minutes at the one-half or three-quarters point of the march. During the rest periods the men may lie upon their backs, but should replace or rebutton their coats and avoid undue exposure to drafts or winds.

It is necessary to assume a strict regimental sanitary discipline along the line of march. A small detail including a medical officer can be sent ahead to select the suitable camp site or resting haven, to investigate the water supply, and to prepare urine pits and shallow latrines.

Great care and many precautions must be exercised at these cursory halts to prevent the casual fouling and contamination of the surrounding vicinity. A sanitary detail should stand watch over this allotted area to insure proper use and care. When the march is resumed these men should fill the trenches and leave the area as clean and wholesome as practical.

Light food may be ingested when two-thirds the distance is covered. The main meal is not served until one-half hour after the days' march is completed.

Selection of a camp site.

The following characteristics recommend a site:

1. Accessibility to a supply of good water, fuel, and forage.
2. Sandy loam or gravel soil.
3. Elevated site, well drained, such as a sloping plateau or high river bank.
4. Shade trees as protection from the sun's rays in warm weather.
5. Hills and forests acting as windbreaks in cold weather.
6. Grass.

The following features are unfavorable.

1. Recent use as a camp site.
2. Dry bed of river, ravine, or base of hills.
3. Clay or alluvial soil.
4. Proximity to marshes, swamps, or other areas of mosquito breeding.

Care of the feet.

It is difficult to overemphasize the value of the proper care of the feet. It is said that during the first days of a campaign 10 to 25 per cent of the men are physically disabled from foot troubles. Of course the prevention of the foot injury while marching depends upon properly fitting shoes and socks. *The common mistake of the recruit is to call for the same size shoe worn in civil life.* With the noticeable difference in the last of the military shoe, especially its width, the man will receive a shoe perhaps three or four sizes too short, and in a few weeks will develop some form of sore feet. To obviate these common mistakes the feet must be measured by an officer, the man must wear his full equipment to cause full expansion of the feet, and the inner surface of the shoe must be a quarter of an inch longer and wider than the foot. It is also essential to keep the feet clean, to prevent abrasions and infections. The feet must be washed daily at the end of the march, clean socks should replace the dirty ones, which should be washed and dried overnight. If water is not abundant the feet can be cleaned by wiping them, particularly the toes, with a wet cloth.

It is equally imperative to wear properly fitting socks; small ones will pinch the feet and readily become torn, forming creases; too large socks very soon fold and crease beneath the feet, bruising and blistering the skin. Torn socks must not be worn while on the march. Repaired socks are also harmful to the feet. It is well to stretch the socks at the end of a days' march. If washing is impossible, change and put them on the opposite feet to the ones on which they were worn the day before.

For tender, sore feet a powder of salicylic acid 3 parts, starch 10 parts, and talcum 87 parts placed within the sock relieves the condition. Rubbing soap or vaseline over the tender area is also useful. Blisters should be pricked with a sterile pin or needle, and the area protected by a small pad. Chafing between the toes is cured easily by cleanliness, a small wedge of cotton separating the toes, and the application of the above foot powder. Corns are treated by salicylic acid collodion or ointment applied nightly after a hot foot bath; usually after four or six applications the corn easily can be removed with a clean instrument. Careful attention to the feet of marching men is as important as the attention bestowed on the rifle, and many foot troubles can be eliminated by the rules described above.

The Venereal Diseases.¹

The venereal diseases are those contracted through sexual intercourse and include syphilis, gonorrhœa, and chancroid. These disease are very prevalent in every community and do a great deal of damage not only to the individuals affected but to the community by reason of invalidism and premature death. In a military service the venereal diseases cause much loss of efficiency. In the year 1917 the British Army lost the services of 98,000 men as a result of venereal disease. During the same year the total number of admissions for venereal disease in the United States Army was 71,955, resulting in 875,553 sick days. In the United States Navy during the nine years 1909 to 1917, inclusive, an average of 158 men out of every 1,000 were admitted to the sick list for venereal disease.

It is highly probable that every person who indulges in promiscuous sexual intercourse sooner or later acquires one or several of the venereal diseases. It has been estimated that 60 per cent of the adult male population of the United States have had gonorrhœa. Now that routine Wassermann tests are made in many large civil hospitals, it is found that from 20 to 30 per cent of all admissions give a positive reaction indicating syphilis.

In 1917, in a large Pacific coast city, 97 per cent of the prostitutes were found to be infected with venereal disease. In a city on the Atlantic coast, 96 per cent of the prostitutes had venereal disease. These statistics may serve as an index of the prevalence of venereal disease among persons who practice promiscuous sexual indulgence.

The effects of venereal disease are far-reaching. In the case of syphilis the effects are in the beginning slight and local, but as the organism which causes the disease spreads throughout the body they become grave. One great danger is that early in the progress of the disease the symptoms are often so trivial that no anxiety is aroused in the patient's mind. The symptoms may be so slight as not to be observed. The patient may not seek treatment and he may succeed in unknowingly infecting other people.

When the infection becomes generalized every organ and every system in the body may be attacked. Syphilis is specially liable to attack the walls of the

¹ Prepared by Lieut. Commander W. M. Kerr, Medical Corps, United States Navy.

arteries. When this occurs the muscular portion of the artery often is replaced by nonelastic fibrous tissue. The artery becomes thickened and hardened. Hardening of arteries is a natural process which accompanies advancing age, but the hardening process resulting from syphilis is much more rapid and dangerous as far as life is concerned. If the arteries of the brain become thickened and hardened the blood supply is diminished and the portion of the brain supplied with blood by the artery affected ceases to exercise its function. What the symptoms will be depends upon what part of the brain is involved, but the condition may cause mental debility, insanity, loss of speech or memory, or paralysis. Syphilis frequently attacks the aorta, the great artery leading from the heart. A part of the wall of the aorta becomes thickened and loses its elasticity by the formation of fibrous tissue which is weaker than the muscle in the wall of the vessel. The force of the blood stream causes a bulging of this weakened part and in time the wall becomes thinner and the bulging greater until eventually a distinct pouch is formed. The bulging of an artery in this manner is known as an aneurysm. The thinning of the wall makes the aneurysm very liable to burst. This often happens and the patient dies suddenly. Syphilis frequently causes disease of the heart or other important internal organs.

Perhaps the most important part of the body attacked by syphilis is the nervous system. Either the brain or the spinal cord, or both, may be affected. Once the organism of syphilis has lodged in the nervous system it is extremely difficult to evict it. A man with syphilis, if he marries, may infect his wife, and a child born after the infection is apt to show grave manifestations of the disease. Syphilis is a most frequent cause of miscarriage in pregnant women.

The local inflammation of the urethra, which is all that most patients see in gonorrhœa, is actually the least of its dangers. Apart from the danger of infection of the eyes and the general infection of the body resulting in heart disease and gonorrhœal rheumatism, the complications due to direct extension of the disease are different in the two sexes. In man all of the organs connected with the genito-urinary tract may become infected. In women grave complications are common. Invasion of the uterus, the tubes, and the peritoneum by the organism is frequent. This invasion takes place either shortly after infection or after the birth of the first child. The gonorrhœa may subside and become quiet in the glands of the mucous membrane of the vagina until pregnancy excites a congestion that increases the virulence of the bacteria causing the disease. By these virulent organisms the child's eyes are endangered at birth; its mother's uterus and tubes immediately thereafter. It is estimated that in 10 per cent of blind children the blindness is due to gonorrhœal infection of the eyes during birth. Over 60 per cent of the inmates of asylums for the blind are made blind by gonorrhœa. Gonorrhœa of the uterus and tubes usually makes a woman sterile—that is, unable to conceive children. Besides depriving a woman of her children, gonorrhœa may render her a permanent invalid—may even cost her her life. It is a curious fact that gonorrhœa in women is either much milder or much more severe than the disease in man. Some women while heavily infected have few or no symptoms of the disease and are not inconvenienced by it. Others are overwhelmed by gonorrhœal abscesses in the tubes, in the pelvis, or by peritonitis. They must undergo severe surgical operations or die; should they recover they often are invalids the rest of their lives.

GONORRHŒA.

Gonorrhœa (clap) is a disease caused by a specific organism called the gonococcus. It affects both men and women but does not occur in any of the lower animals. In men it is due to the deposition of the gonococcus on the mucous membrane of the urethra during sexual intercourse with a woman having the disease. Its usual manifestation is a local inflammation of the infected surface. This inflammation is characterized primarily by redness, swelling, and exudation of pus which appears at the outlet of the urethra as a creamy drop.

The specific organism causing gonorrhœa belongs to that class of bacteria known as the cocci. When stained and viewed through the microscope they

usually are seen in pairs, the adjacent margins being flattened so that each pair looks like two coffee beans placed side by side. Generally they are found in large numbers in the pus of acute gonorrhœa and for the most part are contained within the pus cells. In the earliest stage of the disease, when the secretion is glairy, a considerable number may be seen lying free or adhering to the surface of cells thrown off from the inflamed mucous membrane, but when the condition becomes purulent the large proportion within the pus cells is very striking.

The gonococcus stains readily with methylene blue and is "gram negative"—an important point in differentiating them from other organisms of similar shape occurring sometimes in the urethra.

The incubation period—that is, the time which elapses between the exposure to infection and the onset of the

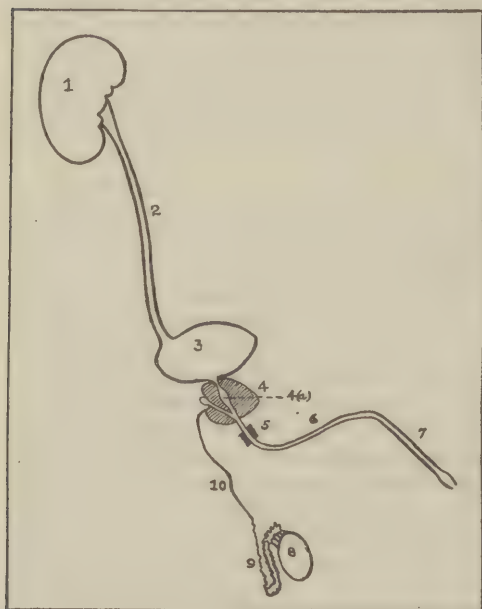


FIG. 165.—Diagram of the male genito-urinary system, side view. 1, Kidney; 2, ureter; 3, bladder; 4, prostate gland; 4(a), posterior urethra; 5, membranous urethra; 6, anterior urethra; 7, pendulous portion of anterior urethra; 8, testicle; 9, epididymis; 10, vas deferens.

symptoms—is on an average from five to seven days.

In order to properly appreciate the description of gonorrhœa as it occurs in the male, some little knowledge of the male sexual organs is necessary. The accompanying illustration is made extremely diagrammatic for the sake of clearness and in order to avoid anatomical details which are unnecessary for our present purpose.

The numeral (1) represents the *kidney*, and passing down from that to the *bladder* (3) is a tube called the *ureter* (2). Urine is produced by the kidney and passes down through the ureter to the bladder where it is stored before being passed out of the body. The urinary passage from the bladder to the outside of the body is known as the *urethra*. It is divided into several parts,

the most inward part, labeled (4a), is called the *posterior urethra*. Next comes a short part (5) called the *membranous urethra*. This is surrounded by a muscle which has the function, when it is contracted, of retaining the urine in the bladder; and when it is relaxed, of allowing the urine to be passed. This muscle is the *compressor muscle of the urethra*. The remainder of the urethra is termed the *anterior urethra*. It runs in the body of the penis to its outlet, which is called the *meatus*. The anterior urethra is subdivided further into the *pendulous* (7) portion. There are two channels entering the posterior urethra. One comes from a gland called the *prostate*. The other comes from the *testicle*. The latter channel is a very long tube and that portion near the testicle is fine and convoluted and is known as the *epididymis*. That portion of the tube between the epididymis and the urethra is the *vas deferens*.

During intercourse the gonococci enter the anterior part of the urethra and proceed to grow into the delicate lining membrane where they set up an inflammation. The disease at first is an acute inflammation of the anterior part of the urethra and hence at this stage often is called *acute anterior urethritis*. About five to seven days after exposure to infection the patient notices a slight sensation of burning, itching, or pain about the meatus. The pain or burning is most marked during urination owing to the irritation caused by the urine passing over the inflamed area within the urethra. After a day or two a small quantity of glairy mucus can be squeezed out from the meatus, the lips of which now are found to be inflamed and have a tendency to stick together.

This mucous stage lasts for about 24 hours and at the end of that time the discharge assumes a decidedly purulent character. The pain is sharper and during urination there is a marked burning sensation in the urethra. The discharge becomes profuse, yellowish-green in color, creamy in consistence, and sometimes tinged with blood, the lips of the meatus and often the entire head of the penis are bright red in color, hot, and swollen. In severe cases the lymphatics on the dorsum of the penis become swollen and painful, and as they communicate with the inguinal glands these latter may become enlarged and tender.

The infection spreads and the entire anterior urethra becomes inflamed. Every act of urination is now painful as the urine is forced through the urethra, whose caliber has been greatly lessened by the swelling of its mucous membrane. The pain may be so severe as to inhibit the passage of urine.

Painful erections occur, especially at night, which rob the patient of his rest, and in this way cause debility, general malaise, and nervousness.

The symptoms increase in severity up to about the third week of the disease, and then in favorable cases gradually decline until at the end of about six weeks the patient is practically normal. The discharge almost disappears and the only reminder of the disease may be a little moistness at the meatus in the morning. The patient perhaps considers himself cured, but may find that any dietetic indiscretion, such as the drinking of alcoholic beverages or sexual intercourse, causes a reappearance of the symptoms.

The foregoing description refers to an uncomplicated and untreated case. Although the patient is free of symptoms, he is not cured. The disease merely has become chronic. The urethra has become tolerant to the gonococcus which is still present, as generally can be shown by microscopic examination.

Chronic gonorrhœa, or gleet as it is sometimes called, is a serious matter. It is the man with chronic gonorrhœa who mainly is responsible for the spread of the disease. The patient is quite unaware that he is in an infective state and

he may marry without any misgiving. The gonococcus to which his urethra is practically immune is then implanted in the vaginal mucous membrane of his wife, and in this fresh soil takes on renewed activity. It not infrequently happens that such a man after a few weeks of married life finds symptoms of acute gonorrhœa developing in himself. He usually suspects his wife and serious domestic trouble may result. In reality all that has happened is that he has been reinfected by his own organisms which have become rejuvenated by their residence in the genital passages of his wife.

The gonorrhœal process rarely is limited to the anterior urethra. In about 90 per cent of all cases of acute gonorrhœa the infection passes quite quickly up the urethra to and beyond the region of the compressor muscle of the urethra. When this locality is passed inflammation is set up in the posterior urethra.

This invasion of the deeper parts of the urethra may take place gradually and with such mild symptoms as to escape detection; but in the majority of cases it is indicated by a sudden and very marked decrease in the amount of discharge at the meatus, accompanied by frequency of the desire to urinate, with inability to hold the urine when the desire come on.

In the mild cases involvement of the posterior urethra may be detected by means of the two-glass test, which is performed in the following manner:

The patient passes the greater part of his urine into one glass and the remainder into another. If the disease is confined to the anterior urethra, the urine in the first glass will be cloudy from the pus washed out of the anterior urethra, while in the second glass it will be clear, as it consists of normal urine from the bladder passed through a urethra which has been washed clean of pus. Should the posterior urethra be involved, however, the pus from it, escaping backward into the bladder, renders all the urine in it cloudy; the urine in both glasses therefore will be cloudy, the first a trifle more so than the second, as it consists of turbid urine from the bladder in addition to the anterior urethral discharge which it washes out.

Gonococci not infrequently enters the duct of the prostate gland, giving rise to an inflammation known as *prostatitis*, indicated by severe pain in the rectum which is generally intensified by defæcation. This inflammation may go on to the formation of an abscess which may burrow in various directions and burst into important near-by structures with serious results. The prostatic inflammation when chronic may give rise to an increase in the size of the gland. As the prostate surrounds the urethra just where it leaves the bladder, this increase in the size of the gland may interfere with the complete emptying of the bladder. The urine thus retained may decompose, become infected, and cause inflammation of the bladder. This inflammation may extend up the ureter and involve the kidney with serious results.

When gonorrhœal infection of the posterior urethra spreads along the vas deferens to the epididymis inflammation of that organ is set up. Such inflammation is known as *epididymitis*. About 5 per cent of all cases of gonorrhœa under treatment develop this condition. The patient first notices a slight tenderness along the course of the epididymis. Later on the pain becomes very severe, and the *scrotum* or bag in which the testicles hang, becomes swollen and puffy. Constitutional symptoms may be severe and the patient's temperature may rise to 104° F. With proper treatment after about a week of acute symptoms the condition begins to subside. Although the patient may not complain of either pain or discomfort, the epididymis has not returned to its normal healthy condition, and the affair tends to become active again on the slightest indiscretion, such as getting out of bed too soon.

The important effect of an epididymitis is that the inflammation often causes the caliber of the epididymis to become narrowed or obliterated, with the result that spermatozoa no longer are able to pass from the testicle to the urethra. In other words, the patient has become sterile on that side. If there has been epididymitis on both sides the patient becomes completely sterile. He still retains his potency but the ejaculated fluid, mainly prostatic secretion, is scanty in quantity and is devoid of spermatozoa. Impregnation of the female is thus impossible, hence the unfortunate patient no longer can reproduce his species.

An important sequel of gonorrhœa is *stricture* of the urethra. By this is meant a narrowing of the urethra by scar tissue at the site of an ulceration set up by the gonococcus. The narrowing of the urethra interferes with the free flow of urine and in time may cause complete retention or inability on the part of the patient to pass his urine.

Treatment of gonorrhœa.

The following outline of treatment is recommended for the use of hospital corpsmen who are on independent duty. All patients with gonorrhœa should be referred to a medical officer as soon as possible.

In the acute stage the patient must be kept quiet. For the first week or 10 days, or even longer if the symptoms of inflammation are very marked, the diet should be light and easily digested. The following articles should be excluded: Ham, bacon, red meats, green vegetables, fresh fruits of all kinds, condiments and spices, coffee, chocolate, cocoa, all alcoholic drinks, ginger ale, and similar effervescent waters.

The testicles must be supported by a well-fitting suspensory bandage, which does not press upward on the urethra at the junction of the penis with the scrotum and thus interfere with the free drainage of the urethra. The head of the penis and the cavity of the foreskin must be kept clean by the frequent washing of these parts with hot water.

The penis should be so dressed as to allow free drainage of the pus from the urethra, which at the same time must be kept from the cavity of the foreskin, the patient's fingers and clothing. These requirements are filled by a piece of gauze cut about 4 inches square, with a slit in the center through which the head of the penis is passed until the gauze rests in the groove behind the head. The foreskin then is drawn down over the gauze which protrudes from the orifice of the foreskin and catches the pus as it is discharged from the urethra. This dressing should be changed several times daily according to the amount of the discharge. If the foreskin is too short to hold the above dressing in place, the end of the penis can be covered by a Bull Durham tobacco bag into which some gauze is placed. Never plug up the cavity of the foreskin with cotton or use cotton in a tobacco bag, as this interferes with the free discharge of pus and will favor the spread of the infection to the posterior urethra. To allay local pain and inflammation the penis should be immersed several times a day in hot water.

A hot sitz-bath relieves to a great extent the feeling of soreness in the perineum. This bath is indicated if the patient has difficulty in passing urine. The heat has a tendency to relax the inflamed parts and the urine may be passed directly into the bath water.

In all manipulations of the penis it is important to remember that the gonococcus when transferred to the eyes will set up a severe inflammation which may result in permanent impairment of vision.

As soon as a case of gonorrhœa comes under treatment the patient should be warned of the danger of infecting the eyes, the necessity of thoroughly wash-

ing the hands after handling the penis, and the danger of contaminating towels, etc., and in this way causing the infection of others.

The bowels should be kept freely open, preferably by vegetable cathartics, as saline purgatives are apt to produce more or less urethral irritation.

To render the urine bland and nonirritating the patient should drink water freely, a glassful every hour during the day and whenever he wakes at night. For the prevention of painful erections the patient should be instructed to empty his bladder just before retiring, to sleep on his side on a hard mattress, with as little covering as possible.

If awakened by an erection, he usually can obtain relief by emptying the bladder and by cold applications to the penis.

When, in a few days, as a result of the above constitutional treatment, the very acute inflammatory symptoms begin to subside, as is indicated by a diminution and thinning of the urethral discharge, less pain on urination, and a decrease in the redness and swelling of the meatus, a bland and nonirritating hand injection, administered by the patient himself, may be employed. For this purpose a solution containing a quarter to a half of 1 per cent of protargol may be used. If the injection causes irritation, as it sometimes does, it must be discontinued for a time, until the irritation has abated, and then resumed cautiously, using a weaker solution than that employed when signs of irritation developed.

Hand injections are given as follows: The patient urinates, wipes the meatus with a bit of gauze, gently inserts the nozzle of the syringe completely filled with the solution used into the meatus, the lips of which are lightly pressed together from side to side against the syringe; the solution then is forced in very slowly until there is a feeling of distention in the urethra, when it may be allowed to escape, or if not too uncomfortable, kept in for a minute or two. While the fluid is being injected the patient should contract the compressor muscle of the urethra, much as if he were trying to hold back the contents of the bladder, in order to prevent the passage backward of any of the medication into the posterior urethra.

If the foregoing treatment has been successful, in about three weeks the patient will have only a trifling urethral discharge, sometimes seen only in the morning, with flakes or shreds in the urine. At this stage the injection should be changed to a solution of zinc sulphate one-half of 1 per cent in strength, administered daily.

The patient should be warned against "stripping" or "milking" the penis in an endeavor to find a "morning drop." This manipulation irritates the inflamed mucous membrane of the urethra and retards healing.

The patient's urine should be watched daily by the two-glass method described above and as soon as evidence of acute posterior urethritis develops all injections must be suspended.

The patient should be kept very quiet and, if possible, put to bed for a few days, on a light, nutritious diet with the testicles properly supported. The bowels must be kept freely open as any accumulation of feces in the rectum is liable to irritate the inflamed deep urethra and the prostate gland.

Water should be taken freely. Hot water bags over the bladder or against the perineum relieve the pain in the deep urethra, as does the hot sitz-bath.

If retention of urine occurs, it should be relieved promptly by the hot sitz-bath, or if that measure fails, by catheterization with a soft-rubber catheter.

When the frequency in urination, bladder irritation, and other acute inflammatory symptoms begin to subside, the local urethral treatment may be carefully resumed and the patient allowed to be up and about.

There are several complications of acute gonorrhœa which require special treatment.

Balanitis.—This is an inflammatory process attacking the mucous membrane of the head of the penis, and if accompanied by inflammation of the mucous membrane lining the foreskin, as it generally is, it is called *balanoposthitis*.

It is caused by uncleanness or by allowing smegma or gonorrhœal pus to collect beneath the foreskin, where more or less inflammation is set up. The condition usually occurs in persons with a long tight foreskin, a condition which prevents retraction and proper cleansing of the parts. In treating this condition the parts must be kept clean by washing with hot water and separated by means of gauze wet in boric acid solution. When the acute process has subsided the parts may be treated by careful cleansing, drying, and the application night and morning of a dusting powder, such as thymol iodide. If the foreskin can not be retracted, the space about the head of the penis may be washed out with hot water or salt solution injected by means of a syringe. If there is considerable swelling of the parts the patient should be kept in bed with the penis enveloped by a wet dressing of salt or boric acid solution. Soaking the entire penis in hot solution is useful.

Phimosis.—This is a deformity of the foreskin which renders its retraction behind the head of the penis impossible because of the small opening in the foreskin. The remedy is circumcision. Often the condition induces an attack of balanitis or balanoposthitis.

Paraphimosis.—This is a condition in which a tight foreskin has been retracted behind the head of the penis and can not be brought forward readily. The small opening in the foreskin forms a band of constriction on the dorsal surface of the penis, which, interfering with the circulation of the blood, causes more or less deformity of the organ from œdema. The condition causes great discomfort and if neglected may go on even to ulceration and gangrene of the foreskin and head of the penis.

The first requirement of treatment is the immediate reduction of the displaced foreskin. This often can be accomplished in the following manner:

With the two thumbs pressing on the head of the penis at either side of the meatus, and the index and middle fingers behind the constriction, the blood is pressed out of the head, which being thus reduced in size and softened, is pushed back through the constricting ring and the foreskin drawn forward.

Should this procedure fail, owing to the tightness of the constriction, a small longitudinal incision must be made, under local anæsthesia, completely through the constricting band, on the dorsal surface, after which the foreskin easily can be brought forward, the wound being dressed with sterile gauze.

Epididymitis.—This is one of the most frequent complications of acute posterior urethritis. The patient should be put to bed and given a brisk cathartic. The enlarged scrotum with its painful contents should be supported by a band of zinc oxide adhesive plaster 3 or 4 inches wide, which passes beneath the scrotum to each thigh, care being taken to have the thighs, legs, and inner borders of the feet close together before applying the plaster. If there is much hair on the thighs it should be shaved off to prevent pain when the plaster is removed.

The scrotum, supported as above described, is surrounded with gauze which is kept wet day and night with boric-acid solution or a saturated solution of magnesium sulphate. When the acute inflammatory symptoms have subsided, as a result of the above treatment, 20 per cent ointment of ichthyol is spread over the scrotum, which then is surrounded by a layer of lint or nonabsorbent cotton, over which is placed a piece of oiled silk or impermeable paper, the

whole dressing being kept in position by a snug suspensory bandage. The patient is allowed to get up four or five days after all pain, tenderness, and temperature have disappeared. If he is allowed out of bed too soon a recurrence of the symptoms is likely.

Prostatitis.—Acute inflammation of the prostate gland is a very common complication of acute posterior urethritis. When infected the gland becomes engorged with blood and swollen. This gives rise to a sense of fullness in the perineum and rectum, accompanied by irritation of the bladder. There is more or less pain in the prostate, as the fecal masses press upon it as they pass through the rectum during defecation. The finger, covered with a rubber finger cot, if introduced into the rectum finds the gland to be enlarged, hot, and painful.

A patient suffering from acute prostatitis should be put to bed immediately. All injections should be stopped and the urine rendered bland by copious drafts of water. The bowels should be moved freely every day, using vegetable cathartics for the purpose. Hot-water bottles over the bladder and against the perineum are useful. Much relief is obtained from the use of hot rectal irrigations of normal salt solution given twice a day in the following manner:

The patient lies on his side with the buttocks near the edge of the bed or table. An irrigating can filled with saline solution at a temperature not over 115° F. is so suspended that its lower end is about 1 foot above the patient's hips. Two rectal tubes thoroughly lubricated with petrolatum are inserted very gently for a distance of about 3 inches in such a way that the outlet of one tube is near the gland. The fluid in the can is allowed to flow slowly into the rectum through this tube and out through the other which may have to be adjusted by withdrawing it a little to obtain a ready return flow. The posterior surface of the prostate thus is bathed with hot saline solution. Each treatment should last from 20 to 30 minutes.

Gonorrhæal ophthalmia.—Gonorrhæal infection of the eye in the adult is caused by the accidental transference of gonorrhæal pus from the genitals to the eyes by means of the fingers, dressings, or towels. It is one of the most serious complications of gonorrhœa as it may result in either partial or complete blindness.

The symptoms usually appear within a few hours after infection and consist of redness and swelling of the conjunctiva, increased lachrymation, accompanied by intense itching and a feeling as if a foreign body were under the lids.

The conjunctivitis is associated with a profuse purulent secretion in which gonococci may be found on microscopical examination.

The eyelids rapidly become red and swollen and the patient is soon unable to open the eye.

The treatment may be divided into prophylactic and curative.

Prophylaxis consists in thoroughly cleansing the hands after administering treatment or after handling the penis, the sterilization of all instruments and the immediate burning of all dressings which have been soiled by gonorrhæal discharge.

When a gonorrhæal infection of an eye is suspected, the patient should be put to bed at once. If only one eye is affected, the sound one is covered with a glass shield to prevent its infection; this shield consists of a watch glass placed against a hole slightly smaller than the glass, in the center of a piece of adhesive plaster 4½ inches square; the adhesive plaster is fastened to the skin about the eye and nose. It is advisable to leave a small area of the plaster nonadherent at the outer edge of the eye to permit the

evaporation of moisture from the skin, which otherwise would collect within the shield.

The infected eye must be washed out day and night with cold boric acid solution as often as any secretion accumulates. This flushing of the eye should be followed by the instillation of a drop of 10 per cent silvol solution into the eye. In the intervals between the washings the eye should be kept covered with cold compresses—squares of gauze taken from a block of ice if possible, and changed every two or three minutes. These gauze squares should be used only once and then burned. Rubber gloves should be worn when giving these treatments. The eye is flushed out by means of an irrigator held high enough to allow the cold boric acid solution to flow out in a gentle stream.

The patient should be gotten to a medical officer as quickly as possible.

By the foregoing methods of treatment the hospital corpsman can not expect to cure a gonorrhœal infection, but by adhering to the treatment advocated he can relieve his patient of many distressing symptoms and shorten the time required by the medical officer to effect a cure.

SYPHILIS.

Syphilis is a chronic, infectious disease caused by a protozoön, one of the lowest forms of animal life, called the *Treponema pallidum*. There are two forms of syphilis: The acquired form and the hereditary form. Acquired syphilis is communicated by a syphilitic person to one free from the disease, the point of inoculation always being marked by a sore which is called the initial lesion or chancre. Hereditary syphilis is transmitted before the patient is born from either one or both parents. In this form there is no chancre, the onset of the disease being marked by general manifestations which may be noticed at the time or shortly after the syphilitic child is born. In this discussion we will confine our remarks to the acquired form of the disease.

The course of the disease may be described best by considering it to occur in three different periods or stages: The primary, the secondary, and the tertiary. These stages are not always clearly defined, as signs or lesions of the tertiary stage may occur in the secondary stage, or vice versa. To avoid this confusion some writers speak of early lesions and late lesions; that is, those occurring early in the course of the disease and those occurring late.

Primary stage.—The primary stage of syphilis consists of two periods of incubation, the first of which exists from the time the *Treponema pallidum* enters some abrasion to the appearance of the initial lesion or chancre and, as a rule, lasts from 14 to 21 days; but it may be as short as 10 or as long as 70 days. This is followed immediately by the second period of incubation, which dates from the formation of the initial lesion to the development of certain constitutional manifestations, and usually occupies 40 to 45 days, but may be prolonged to 60, 70, or even 90 days. In other words, the primary stage represents a progression of the *Treponema pallidum* throughout the body. It first gains access through some minute abrasion, multiplies at the site of that abrasion, forming the chancre, then the treponemata pass through the lymphatics into the general blood stream and are distributed all over the body. The entire duration of the primary stage averages from 50 to 80 days. The site of the primary lesion is generally marked by a scar.

Secondary stage.—The secondary stage of syphilis, or the stage of constitutional manifestations, is characterized by superficial lesions of the skin and mucous membranes and enlargement of the lymphatic glands throughout the entire body. The superficial lymphatic glands easily may be felt under the skin.

In many patients there also may be various constitutional disturbances such as fever, headaches, pains in the bones, muscles, and joints, and a general feeling of debilitation. The duration of this stage is variable, usually lasting from one to two years, depending greatly upon the constitution of the patient.

Tertiary stage.—This stage usually begins at about the end of the second year, but is not observed so frequently now as formerly, owing to modern methods of treatment. It manifests itself by destructive lesions in various portions of the body, also by affections of the nervous and vascular systems, the various organs of the body, and the bones.

The secretion of the chancre is highly contagious, as it teems with treponemata. The secretions of the secondary lesions and the blood and lymph in the secondary stage are also contagious. Tertiary lesions are also often infectious, but they do not contain as many treponemata as the primary and secondary lesions.

Syphilitic infection may result from direct contact with a syphilitic person either through sexual intercourse, kissing, or the handling of open lesions, or it may be contracted from syphilitic secretions deposited upon any article used by a syphilitic person and then transferred from it to a healthy person. Among such articles may be mentioned cigars, cigarettes, pipes, toothbrushes, pencils, chewing gum, handkerchiefs, drinking and eating utensils, musical instruments, razors, surgical and dental instruments, unless properly sterilized, etc.

Symptoms.

The initial lesion or chancre.—It is produced by inoculation of syphilitic blood or the secretions of primary, secondary, or tertiary lesions, appears generally from 14 to 21 days after inoculation, and is situated always at the point where the *Treponema pallidum* entered the body. Usually there is but one initial lesion, although several may be present at the same time, infection having occurred simultaneously at several points.

Chancres found upon the genital organs are called *genital* chancres, while those situated elsewhere upon the body are designated as *extragenital* chancres. Most frequently the initial lesion occurs upon the genitals, but it may be located anywhere on the body, as the lips, tongue, fingers, etc.

There is nothing absolutely characteristic in the appearance of the initial lesion in its very early stage. Generally it begins as a small erosion from which exudes a variable amount of serous secretion in which the *Treponema pallidum* may be found by appropriate methods on microscopical examination. It may appear as a small dry papule, as a small silvery spot, or a purple nodule. Whatever the form first assumed the chancre develops into a superficial ulceration which often is surrounded by a hard ring of induration. This ring of induration is rather characteristic of the chancre.

Since the discovery of the *Treponema pallidum* and methods of demonstrating this organism under the microscope, many innocent-looking ulcerations which formerly would have been considered as trivial infections have been found to be syphilitic. For this reason all ulcerations encountered by hospital corpsmen on independent duty should be referred to a medical officer as soon as possible for microscopic examination of the secretions. Syphilis to-day is treated by the intravenous administration of certain preparations of arsenic such as salvarsan or neosalvarsan which kill the treponemata in the tissues. If a diagnosis can be made during the stage of the initial lesion before the treponemata have been able to cause many changes in the patient's tissues, he is cured more easily. Hence no antiseptic dressing should be applied to any suspicious

ulceration before its secretion has been examined microscopically. Antiseptics tend to kill off the treponemata in the lesion, making it difficult or impossible to make a positive diagnosis at this stage. If the medical officer has to wait for the appearance of secondary lesions to confirm his diagnosis much valuable time is lost.

By the time the chancre is formed the treponemata have multiplied and passed along the lymphatics to the adjacent lymphatic glands or even into the general blood stream. Therefore it will do no good to excise or to cauterize the lesion with the hope of preventing the spread of the disease. The chancre should be kept clean and protected by a dressing from all sources of irritation and infection.

A dressing wet with salt solution should be used until the secretion has been found to contain *Treponema pallidum*. After this the lesion should be washed with bichloride of mercury solution (1:5,000) night and morning and kept covered with a dressing wet with this solution. In the later stages when there is little secretion a dusting powder of equal parts of calomel and boric acid may be used.

When the chancre is well developed the lymphatic glands in its immediate vicinity become indurated. Unless the chancre has become infected with pus-forming organisms, these glands are painless, freely movable, and separate from each other.

Secondary stage.—A few weeks after the appearance of the chancre a rash known as the primary rash makes its appearance. This early skin lesion generally consists of small spots or macules which are at first pinkish, then fading to a brownish red, although it may assume a variety of forms. This rash is symmetrically distributed over the trunk, neck, and limbs. Sometimes the face is involved. The rash does not itch, and frequently is not noticed by the patient. By the time the rash is well developed the patient frequently experiences sore throat, some hoarseness, headache, and generally there is an elevation of the temperature. The hair on the back of the head may become thin in patches. The primary rash is followed in untreated cases by an infinite variety of skin manifestations in the shape of macules, papules, pustules, or combinations of these lesions. Many of these lesions are altered in appearance by the heat of the body, moisture, and pressure. An example of a skin lesion altered in this way is found in the moist patches, or condylomata, as they are called, which form about the anus. They are lesions which vary from one-third to three-quarters of an inch in diameter and are either round or oval. The edges are sharply defined and rise at right angles to the skin. The top is flat and covered with glistening secretion which swarms with treponemata.

At the time of the primary rash and long after it has faded certain lesions called mucous patches may be seen in the mouth. They are small erosions of the mucous membrane most commonly seen on the inner surface of the lips, especially at the angles of the mouth, but they are found also on the pillars of the fauces, the tonsils, and tongue, the mucous membrane lining the cheek, on the gums, and even upon the pharynx. These lesions are sharply circumscribed and there is usually no inflammatory area surrounding them. The secretion from them is highly infectious.

Early in the secondary stage the Wassermann test for syphilis based upon the phenomenon of blood complement fixation is generally positive.

The tertiary stage.—The tertiary or late stage of syphilis is characterized by the formation of tumorlike processes called gummata and the deposition of fibrous tissue in various organs. Either deep or superficial structures may

be attacked, but the *Treponema pallidum* has a marked predilection for nervous tissues, the arteries, bone, skin, liver, testicles, and the eye. This stage generally begins not less than 18 months after the appearance of the initial lesion, and it may be delayed for even 20 or more years. Locomotor ataxia and paresis, which are syphilitic affections, quite frequently appear years after the primary infection.

Treatment of syphilis.

The treatment of this disease should be begun just as soon as the diagnosis is made. This applies especially to the chancre stage, where, as has been mentioned, the outlook is much better if efficient medication is administered before the treponemata have had an opportunity to produce tissue changes throughout the body. The physician no longer waits for the appearance of secondary lesions, for now by means of the dark-field illuminator he often can diagnose syphilis positively just as soon as the initial lesion becomes manifest.

In the Navy syphilis is treated principally by the administration intravenously of arsphenamine or nearsphenamine.

A board of medical officers composed of representatives of the Army, Navy, and Public Health Service, appointed to investigate safe methods of administering arsphenamine and nearsphenamine has recently recommended the following standard instructions for the preparation and intravenous administration of these preparations for use by the Medical Department of the Army, of the Navy, and by the Veterans' Bureau and the Public Health Service.

The administration of these preparations is never to be attempted by a hospital corpsman. These instructions are placed here in order that hospital corpsmen may have information regarding an accepted method of preparation of arsphenamine and nearsphenamine for administration by a medical officer.

ARSPHENAMINE.

I. Method of injection.

Only the gravity method should be employed in administering arsphenamine.

II. Materials required.

- A. Erlenmeyer flasks, 500 to 1,000 c. c. capacity.
- B. Funnels, glass, 4-inch.
- C. Cylinders, graduated, 500 to 1,000 c. c. capacity.
- D. Gravity apparatus, consisting of—

1. Gravity graduated glass cylinders, 300 c. c. capacity; long graduations at the 100 c. c. marks; medium long graduations every 25 c. c.; short graduations for each 5 c. c.; the zero point to be at the top and the 300 mark to be at the bottom of the cylinder.

2. Rubber tubing, pure gum, heavy wall, inside diameter, five thirty-seconds inch (about 4 mm.) of lengths to limit height of the cylinder to 3 feet above the patient's arm.

Caution.—Before being used the first time the tubing should be filled with normal sodium hydroxide solution for not less than six hours. It then should be rinsed thoroughly in water, sterilized by boiling, and then be rinsed carefully with sterile water again just before using.

3. Needles with slip joint, 19 standard gauge, medium bevel, length of cannula $1\frac{1}{2}$ inches. While not necessary, the Fordyce type of needle is a great convenience. The correct gauge is highly important, as it influences the rate of flow. Proper care of the needles is important. They should be cleaned immediately after use and precautions taken to prevent rust. Just before

sterilization the point should be freshened on a stone, if necessary. A dull needle tends to make a dissatisfied patient.

4. Glass tubing, 6 mm. in diameter, for windows, which should be inserted in the rubber tubing so as to be a few inches from the lower end.

5. Adapters for attaching needles to end of tubing. These may be of metal or glass. If of glass, they will serve as extra windows as well as adapters.

6. Pinch cocks (Mohr's) for cutting off the flow to be applied a short distance above the needle.

E. Sterile gauze, cut in small squares for filtering the solution.

F. Sterile freshly distilled water. This water should be distilled in glass or block tin and should be sterilized immediately by autoclaving or boiling in Erlenmeyer flasks. These flasks should be stoppered with a gauze-wrapped cotton plug and capped with paper or tin foil. Preparation of the water should preferably be carried out on the day before use so that it will be fresh and cool at the time needed.

G. Sterile salt solution. This should be made with water prepared as above and chemically pure sodium chloride. Sterilization should be carried out as given above. The strength of the salt solution should be the usual 0.85 per cent. The use of salt solution in the place of distilled water for the dilution is considered a refinement which is not necessary in routine work, but it may have some advantages, since a solution of arsphenamine in distilled water is not isotonic.

H. Normal sodium hydroxide volumetric solution (U. S. P. IX, p. 573). Enough of this can be prepared at one time to last for a month or longer, provided it is kept in a rubber-stoppered wax or paraffin lined bottle. There is danger of deterioration on account of absorption of CO_2 from the air and of reactions with the glass container. A wax-lined bottle can be prepared by placing wax or paraffin in a bottle, melting it with dry heat, and spreading the melted wax by rotation over the inside of the bottle as it is cooling. If precipitate is found in the alkali, it is probably an evidence of deterioration of the solution, which should be discarded.

I. Burette or pipette. A graduated burette or pipette for accurately measuring the alkali.

All the glassware mentioned above should be of chemical standard. All apparatus should be surgically clean, freshly sterilized, and cool at time of using. The apparatus should be sterilized by dry heat or autoclave with the exception of the tubing and the needles, which should be boiled.

If the medical officer has any doubt about being able to obtain pure normal sodium hydroxide solution the same will be supplied on request to the Naval Medical School, Washington, D. C.

III. Inspection of drug.

A. Note and record manufacturer, lot number, and particularly the dosage stated on the label.

B. Examine ampules critically and do not use any which are cracked or in which the powder is not freely mobile and is not of a pale yellow to a lemon yellow in color. Forward any suspected ampules, with explanatory letter, directly to the Hygienic Laboratory, Washington, D. C., for examination.

C. The ampules, having satisfactorily passed preliminary inspection, should be immersed in 95 per cent alcohol primarily to detect any minute cracks in the glass not visible on preliminary inspection, and also to cleanse the ampule. Lay ampules on sterile towel to dry, or wipe off alcohol with sterile gauze.

IV. Preparation of solution.

A. The amount to be prepared at one time will depend on the number of patients, but unit quantities of more than 10 average doses should not be prepared.

B. Place in Erlenmeyer flasks about 10 c. c. of freshly distilled sterile water for each decigram of arsphenamine to be used, e. g., 100 c. c. for 1 gram. Open ampule and sprinkle—do not dump—contents on surface of water. The temperature of the water is of great importance. For all brands of arsphenamine, except for arsenobenzol manufactured by the Dermatological Research Institute, the water should be at room temperature and, as a rule, the drug should go into solution with little or no agitation within a few minutes. A slight amount of shaking is permissible with any product, but always should be kept at a minimum.

Exception.—The arsphenamine manufactured by the Dermatological Research Institute requires either hot water alone, or it can be dissolved in cold water, if the powder first is moistened thoroughly with ethyl alcohol (about 1 c. c. to 0.6 gram). This amount of alcohol is harmless.

When the arsphenamine has completely dissolved, forming a perfectly clear solution with an absence of any gelatinous particles when viewed by transmitted light, it is ready for alkalinization. If for any reason the arsphenamine fails to form a perfect solution it must be discarded.

C. *Correct alkalinization* is extremely important; failure to alkalinize properly causes more reactions than any other error connected with the use of arsphenamine.

1. The exact method consists in the addition, all at once, of 0.85 c. c. normal sodium hydroxide solution for each 0.1 gram of arsphenamine used, e. g., 8.5 c. c. for 1 gram of drug. This is the correct amount necessary to form the disodium salt of arsphenamine, the form which is best tolerated by the patient.

2. Approximate method of alkalinization. An exception to the rule that only standardized normal alkali should be used may be made in case this is not obtainable. Under such circumstances, the exact concentration of alkali being unknown, the operator should keep in mind the following facts: Arsphenamine as it appears on the market is the dihydrochloride of the arsphenamine base which is soluble in water, but the solution is strongly acid and highly toxic. Upon the gradual addition of sodium hydroxide, a precipitate at once begins to form and then redissolves. This property of the drug, not understood by some physicians, has caused them to mistake the end point. This mistake is especially apt to occur when the operator thinks he is using a 15 per cent solution, when in reality the solution is only 4 or 5 per cent. The drug when injected in this still strongly acid state, the monohydrochloride, produces serious reactions and sometimes death.

When a little over one-fourth of the amount of alkali indicated under (1) has been added, the precipitate no longer redissolves. From this point on until there has been added almost three-fourths of the amount of alkali necessary to form the disodium salt, the precipitate remains and does not redissolve on shaking. But when three-fourths of the total amount necessary has been added the precipitate redissolves.

It is at this point, when just enough alkali has been added to dissolve the precipitate, that the solution very frequently has been injected. *This solution of the monosodium salt is the most frequent cause of reactions.* At this point 75 per cent of the correct amount of sodium hydroxide solution has been added and hence an additional one-third of the total amount of alkali used up to this

point should now be added. This last addition is the remaining 25 per cent of the correct amount corresponding to a total of 0.85 c. c. per 0.1 gram of standardized N/1 NaOH solution as mentioned under (1) above; e. g., if 3.3 c. c. of an unknown solution were required for completely clearing a solution containing 2 grams of arsphenamine, 1.1 c. c. more should be added. With a thorough understanding of the above the operator may roughly standardize his alkali against the arsphenamine. No two brands of arsphenamine vary greatly in the amount of alkali required, while various alkali solutions vary in strength by several hundred per cent.

The pH of a proper solution is about 10, and it is impossible to buffer it to neutrality by common buffers without precipitation. Moreover, the alkaline solution is well tolerated if given slowly and well diluted.

3. "Haphazard method" of alkalization, or drop method. This is mentioned only to condemn it. It is inconceivable that the operator will be unable to secure some sort of a graduated measuring device in order to measure the alkali instead of guessing at the amount. Numerous reactions from underalkalinization have occurred with this method, particularly where several doses of the drug are prepared at one time. The alkali has been added with a dropper until clearing occurred, and then a few additional drops have been added regardless of whether the solution contained 1 or 10 doses. Less frequently overalkalinization also has occurred. The injection of an overalkalinized solution causes pain along the vein and thrombosis.

D. *Filtration and dilution to proper strength of the alkalinized solution.*—With sterile forceps place four layers of sterile gauze in the funnel. Wash with sterile water. Pour alkaline solution through into a graduated cylinder and then rinse the filter with enough sterile distilled water to bring the total for each decigram of drug up to 25 c. c.; e. g., for 1 gram of arsphenamine 250 c. c. of solution should be made. This washing the drug through the filter with the water insures full dosage. If a saline solution is desired, it is used at this point in place of the distilled water, at usual strength, 0.85 per cent.

E. *Time the solution should be allowed to stand.*—The properly alkalinized, filtered, and diluted solution now should stand for at least 30 minutes before being injected, to allow complete stabilization of the reactions. The toxicity is considerably reduced by this delay. The solution may stand as long as three hours without undergoing any increase in toxicity, provided it is protected from the air, not shaken, and provided the temperature does not exceed 30° C. The solution is now ready for administration.

F. *Temperature.*—30° C. is the correct temperature at which the drug should be introduced; in no case should it be warmed above this point.

G. *Dosage.*—As a rule the initial dose should be small. The average dose used is about 0.4 gram for 150 pounds body weight, but no hard and fast rule can be laid down; each case should be considered individually by the clinician. When a radical cure is being sought and the patient tolerates the injection well, full doses should be given.

V. Administration.

A. Emphasis should be laid on the complete physical examination preliminary to administering arsenical treatment for evidence of renal, cardiovascular, or visceral changes, in the presence of which it should be used cautiously. Weekly urinalyses should be made during treatment. The patient should be questioned concerning any reactions following the last treatment, with special reference to any toxic skin eruptions as danger signals against further treatment. Any evidence of an exfoliative dermatitis is an absolute contraindication

against any further treatment with any arsenical. Evidence of jaundice also should be looked for and if present is an indication for caution. In late cases the possibility of a Herxheimer reaction following a large injection should be remembered. This may be fatal should vital structures be involved. *Each patient should receive individual consideration and not simply be run through the mill.*

B. *Preparation of patient.*—A mild cathartic should be given the night before and no food should be eaten within two or three hours before the injection. Only a light meal should be taken a few hours following the injection. Ambulatory patients should rest for a short time after the injection. If large doses are being given, the patient preferably should be kept in bed until the following morning.

C. The patient should be placed in a recumbent position.

D. The gravity apparatus should be arranged to provide a column of solution not over 3 feet in height. The tubing should be rinsed with sterile water, then the cylinder and tubing should be filled with the solution and the air expelled by elevating the end of the tube above the level of the fluid in the cylinder. Apply pinchcock.

E. Select a suitable vein in either arm and sterilize the overlying skin by applying tincture of iodine, which preferably should be removed after a minute or two with 95 per cent alcohol.

F. Apply rubber tourniquet.

G. Insert needle, bevel up, in two stages, and allow a few drops of blood to escape to indicate entrance to the vein. The needle should be slid well into the vein, in order to avoid escape of the point from the vein on further slight manipulations. Now connect adapter attached to gravity apparatus. Open pinchcock and snap it over window.

H. *Rate of injection.*—If the specifications as to the gauge of needle, etc., have been followed, the correct rate of injection practically is insured, i. e., by the size of the needle and the length of the tube; however, this should not be taken for granted, but the exact time should be observed and in no case should the rate exceed 25 c. c. in one minute or 0.4 gram dose in four minutes; five minutes is preferable. A graduated sand glass which runs for five minutes is a convenient timer. The rate of flow should be even as well as slow. Should patient show any signs of reaction, stop. It is highly desirable, in sensitive patients, to wait a minute or two after injection of first 0.1 gram before proceeding with rest of injection. When the necessary amount has been injected, cut off flow with pinchcock, disconnect tubing, allow a few drops of blood to escape, and then withdraw needle and place sterile gauze over the puncture, instructing the patient to hold it there for a few minutes. If another injection is to be given immediately, run a little fluid out of the tube; if any blood shows, empty cylinder and start over with a new sterile tube.

NEOARSPHENAMINE.

I. Method of injection.

The use of the gravity method is strongly recommended, especially in clinics where a considerable number of doses are to be given. It was demonstrated in one clinic that the average time required to give 100 injections was reduced, without changing the personnel, when the gravity method was substituted for the syringe method and a high percentage of reactions due directly or indirectly to the syringe method also ceased to occur. With the gravity apparatus arranged to deliver a dose in about four minutes, one operator was able to run two tables much more easily than one table with the syringe method.

It is recognized, however, that there are circumstances in which the syringe method is indicated, as in the field where apparatus must be reduced to a minimum. Under these circumstances the use of nearsphenamine by the syringe method is a valuable therapeutic measure. It fills a need, but technically is inferior to the gravity method, and therapeutically either method is inferior to arsphenamine given by the gravity method.

II. Apparatus required.

A. When the gravity method is to be used:

1. Gravity apparatus (see Arsphenamine).
2. Erlenmeyer flasks, 50-300 c. c.
3. Funnels, glass, 2-inch.
4. Sterile gauze.
5. Graduated glass cylinders, 100 to 500 c. c.
6. Sterile distilled water (see Arsphenamine).
7. Saline 0.85 per cent prepared as (see Arsphenamine).

B. When syringe method is to be used:

As above, except in place of gravity apparatus—

1. 20 to 50 c. c. all-glass syringes.
2. Rubber tubing, short, with adapters connecting syringe and needle.
3. Needles, 25 standard gauge, medium bevel.

III. Inspection of drug.

An even more critical examination should be made than in case of arsphenamine, as nearsphenamine occasionally decomposes in the ampule, even when no cracks are present. The powder should be freely mobile and canary yellow to orange red in color. When it approaches a red color, is distinctly lumpy or solidified, do not use, but forward samples to the Hygienic Laboratory for examination.

Immerse in alcohol the ampules which have passed inspection to further eliminate the presence of cracks and to clean the ampule.

IV. Preparation of solution.

A. *Amount to be prepared at one time.*—In marked contrast to the practice with arsphenamine, do not prepare any more solution at one time than can be administered within 20 minutes.

B. *Concentration.*—Preferably 1 decigram should be dissolved in 12.5 c. c. of water. This solution is then twice as concentrated as an arsphenamine solution. Concentrations as high as 1 decigram in 0.5 c. c. of water can be used in the field or under other special circumstances. The highly concentrated solutions, however, should be given very slowly.

C. *Solution.*

1. Put in Erlenmeyer flask 12.5 c. c. sterile distilled water for each decigram of nearsphenamine. In the field the concentrated solution can be made in the ampule itself by using water supplied in another ampule.

Caution.—The distilled water used must be at room temperature and not to exceed 30° C.

2. Open ampule and sprinkle—do not dump—powder into the water and by preference allow to go into solution with no agitation whatever. Slight rotation of the flask is permissible. *Shaking the solution increases its toxicity and should be avoided.*

In case the solution does not form a perfectly clear and transparent solution it should under no circumstances be used. Whether it requires 1 minute or 10 minutes for the drug to form a perfect solution is unimportant, but it should not require more than 10 minutes. The important point is not the rate of solubility but the complete solubility of the drug.

3. As soon as the nearsphenamine is in solution *filter* through washed gauze into tall, narrow cylinders and keep stoppered. It is preferable to use a size of cylinder which the solution will nearly fill. The smaller the air column over the solution the less the danger of increased toxicity. The solution is now ready to inject and, in marked contrast to the arsphenamine solution, which should stand at least 30 minutes before its injection, the nearsphenamine solution should be injected *immediately*, and in no case shall it be allowed to stand longer than 20 minutes.

4. *Dosage*.—The initial dose as a rule should be small. The average dose is about 0.6 gram for 150 pounds body weight, but no attempts to lay down a hard and fast rule in this regard are made. The patient must be individualized.

V. Administration.

The directions made under arsphenamine apply to the administration of nearsphenamine with the exception of the dosage, rate, and method of administration.

Rate.—If instructions have been followed, the proper rate practically is insured by the character of the apparatus, but it must be checked by using a timepiece, and in no case, *whether the gravity or whether the syringe method is used, should more than 0.1 gram of nearsphenamine be injected in 30 seconds* or 0.6 gram in 3 minutes. This time is one-half that required for arsphenamine. In giving concentrated solutions especial care is necessary in order to carry out this rule.

In conjunction with the administration of salvarsan and neosalvarsan, mercury often is given, usually by inunction—that is, by being rubbed into the skin—or by intramuscular injection.

The method of inunction is as follows: Five grams of mercurial ointment are rubbed daily or every other day into a portion of the body which is free from hair. The part to be used should be washed first with hot water and soap, and the ointment should be rubbed in well. This may be done either by the patient himself or by some one else, and in the latter case the back may be used. The rubbing should be continued until the ointment has disappeared, which usually takes about one-half hour. A different part of the body should be selected for each of seven days. The first day rub the ointment into the inside of the right arm, the second day into the left arm, the third day into the inside of the right leg, the fourth day into the left leg, the fifth day into the right flank, the sixth day into the left flank, and the seventh day into the abdomen. After a few days' rest the treatment is begun again, using the right arm.

In the administration of mercury by intramuscular injections either soluble or insoluble preparations are used. Of the former may be cited as an example bichloride of mercury in sterile, watery solution, 1 cubic centimeter containing 0.02 gram, which is given in doses varying from 0.01 to 0.02 gram every three to five days. Salicylate of mercury is an insoluble form often used in a 10 per cent suspension in sterile liquid petrolatum. One cubic centimeter of this suspension contains 0.06 gram. The dose is from 0.03 to 0.06 gram every five to eight days. The mixture must be thoroughly shaken just before use.

The injections are given with an all-glass syringe, preferably a 2 c. c. Luer type, and a platino-iridium needle about an inch and a quarter long. The injections are given in the buttocks. The patient should lie on his side or abdomen or bend over a table. The sight of the injection is painted with tincture of iodine. The needle is inserted at right angles deeply into the muscles. There is very little pain if the needle is sharp. The piston of the syringe should be drawn up slightly to make sure that the needle is not in a

blood vessel—a very important point, as death may result if the oily suspension is thrown into a blood vessel. The injection is made slowly, and the needle is withdrawn rapidly, and firm pressure, with a rotary motion, using a small piece of sterile gauze, is made over the site of the injection. If this is done carefully, it is very rare for any of the suspension to leak out. The puncture point should be covered with a small collodion dressing.

CHANCROID.

The chancroid is an acute inflammatory destructive ulceration whose action is local in character and limited to the parts upon which it is situated and to the lymphatic vessels and glands which are in anatomical relation to those parts. It is commonly venereal in origin. The secretion of a chancroid is highly infectious, and the condition may be transferred by inoculation in an abrasion of the skin of another person or upon the individual already the victim of it. It is not a generalized disease like syphilis, but is in reality a form of infected wound. A specific bacteria, the *bacillus of Ducrey*, has been reported as the cause of chancroid, but the condition is peculiarly liable to mixed infection. A smear taken from the surface of the ulcer usually shows numerous pyogenic bacteria, and few if any of the specific bacilli. Hence such a smear can not be depended upon for diagnosis. Frequently syphilitic infection and chancroid virus exist in the same ulceration, the patient having been inoculated with both diseases at the same time.

Chancroids upon the male genitals are most common in the groove behind the head of the penis, especially in the little pocket on each side of the frænum, but they may affect the head of the penis, the inner surface and free border of the foreskin, and the skin covering the penis.

The condition commonly begins as a single ulcer, but often secondary ulcerations are formed quickly by inoculation with the secretions, so that by the time the patient reports for treatment several sores are present.

The chancroid has no fixed period of incubation, usually appearing two to five days after infection.

The rapidity of its development depends on the resistance of the tissues upon which it is situated. Chancroids develop much more rapidly on mucous membrane than they do upon skin, which appears to offer more obstruction to the invasion of the causative organisms.

The chancroid usually begins as a small pustule, about which is a highly inflammatory area. The pustule soon breaks down, leaving a round or irregular ulcer, with sharply defined edges and undermined walls. The floor of the ulcer is rough and generally is bathed by a purulent secretion. The ulcer sometimes bleeds easily and it may be very painful. There is a varying amount of inflammatory thickening of the tissues around and beneath the sore, which shades off gradually into the surrounding parts, thus differing from the ring-like induration of the syphilitic chancre, which is hard and sharply outlined. The ulcer has a tendency to spread.

The chancroid is prone to certain complications of which the most common are mixed infection with syphilis, mixed infection with pyogenic organisms, destruction of the frænum, phimosis, balanoposthitis, lymphangitis, and inguinal adenitis (bubo).

When a patient has what appears to be a chancroid one can never be sure that he has not a chancre (syphilis). This rule is without exception. For this reason whenever possible the serum exuding from every ulceration on the genitals which appears after intercourse should be examined microscopically

for *Treponema pallidum*, and no antiseptic dressing should be applied until after this examination has been made.

Unless neglected or irritated by underclothing or dressings chancroids sometimes heal quickly. A chancroid at the opening of the foreskin, however, is usually a long time in healing. The friction of underclothes or even the softest dressing so irritates the sore that though it may lose all its chancroidal characteristics and become a simple sluggish ulceration it lingers after weeks of the most painstaking treatment.

A chancroid beneath a long foreskin, however loose, usually produces an acute inflammation in the foreskin, the swelling of which produces a phimosis. This retains the secretions of the chancroid, which, bathed in this irritating pus and protected from effective treatment, promptly invades both the head of the penis and the foreskin, and instead of healing tends to eat its way through these parts. If the foreskin is retracted in an effort to get at the lesion, a paraphimosis which can not be reduced complicates matters.

A common complication of chancroid is destruction of the frænum in the following manner. A chancroid appears at once on both sides of the frænum; as it enlarges it eats a hole in the frænum, leaving a narrow bridge of tissue which in time is eaten away. This ulceration as long as the bridge of tissue is present is very resistant to treatment.

In chancroid of the penis the infection may enter the lymphatic vessels causing an inflammation of these channels (lymphangitis). The infection travels along these vessels to the inguinal glands. The glands in either one or both groins become enlarged, matted together and very painful (*adenitis*). In a short while the skin over them assumes a red, brawny appearance. Suppuration of the glandular mass soon begins; an abscess forms which if not incised ruptures spontaneously, leaving a deep, sloughing pocket with undermined and broken-down edges. The infected mass in the groin often is called a bubo.

This complication is very frequent, occurring about once in every three cases.

Treatment of chancroid.

Whenever it is possible to have the serum of the chancroid examined microscopically for *Treponema pallidum* use a simple wet dressing of salt solution until after the examination. The treatment of the lesion depends somewhat upon its situation, the important points being to keep it absolutely clean, free from all irritation, separated by dressings from healthy tissues, and never to cauterize it.

The ulcer and surrounding parts should be thoroughly washed in hot bichloride of mercury solution (1-5000) three times a day or more frequently if indicated. Dry the ulcer and dust it with powdered silvol crystals, then apply a moist salt solution dressing.

All dressings used upon or about the sore must be destroyed and the hands should be washed carefully immediately after the dressing is completed in order not to transfer the infection. Warn the patient to avoid all violent exercise and to walk about as little as possible in the hope of preventing suppurating inguinal glands. Watch the groins carefully and at the first sign of painful matting together of the glands put the patient to bed with a hot-water bottle over the swelling.

Do not, under any circumstances, paint the swelling with iodine. It does no good and causes irritation of the skin, so that if the bubo does eventually suppurate and is opened the surrounding skin is ready for infection.

More or less extensive inflammation of the penis calls for soaks of hot bichloride of mercury solution (1-5000), wet dressings, rest in bed, elevation of the penis, and incision if pus forms in the cellular tissues.

When chancroids are situated beneath a long, tight foreskin, which can not be retracted, a good plan is to make two lateral incisions under local anæsthesia through the foreskin which expose the head of the penis for inspection and local treatment, thus preventing sloughing with more or less destruction of the head of the penis and surrounding parts. This operation is performed in the following manner:

The patient having been anæsthetized, the parts are shaved and rendered surgically clean; with heavy scissors or a scalpel and grooved director a lateral incision is made through each side of the foreskin from its free edge down to the groove behind the head, thus forming an upper and a lower flap, which, when retracted, expose the entire head of the penis and the inner surface of the foreskin. The chancroids then are treated as already described, and the raw edges of the wounds protected from infection by frequent dressings and irrigations with very hot bichloride solution. The bleeding, which usually is quite pronounced, is controlled readily by the pressure of the dressing. When the infection has subsided and the wounds have healed, the flaps may be trimmed off by a medical officer, leaving a scar as in ordinary circumcision.

Never attempt to pull back a tight foreskin. The paraphimosis which will probably result is not easy to reduce, and is the most common cause of gangrene of the penis.

When a chancroid has eaten through the frænum leaving a bridge of tissue, the bridge should be cut between two ligatures and the chancroid treated in the way recommended. The incision of the bridge of tissue hastens healing considerably.

An abscess of the inguinal glands should be drained by a very small incision followed by injection of a 10 per cent iodoform-in-petrolatum ointment, using an ordinary conical glass penis syringe previously filled with the ointment. A cold, wet bichloride dressing is applied with a fairly firm spica bandage, the cold congealing the ointment in the abscess cavity and thus preventing its escape into the dressing. The patient should be kept quiet in bed for two days. The dressing is removed at the end of the second day, all pus wiped away, the skin cleaned, and the abscess cavity filled with the ointment; the wet dressing and the spica bandage again applied. This treatment removes the pus and relieves the pain, but does not always cure the condition. Later on the infected glands may have to be removed by a medical officer.

VENEREAL WARTS.

These usually appear as small wart-like growths springing from the mucous membrane of the head of the penis or the inner surface of the foreskin, the region of the frænum or the margin of the meatus. They are not necessarily venereal. Their cause usually can be traced to irritation incident to prolonged contact with inflammatory discharges. Thus, in the uncleanly with long foreskins, in those suffering from gonorrhœa or chancroid, these growths are not uncommon. The redundant or phimotic foreskin which prevents proper cleansing is an important predisposing cause.

The *treatment* consists of complete removal of the growth with possibly circumcision, and this is the only reliable treatment.

HERPES.

Herpes is a condition which is not venereal but which is mentioned in this connection because of its frequency and the liability of its confusion with venereal sores. This affection is characterized by the rather sudden appearance of small blisters upon a reddened base. Commonly they appear in or about the groove behind the head of the penis, involving both the head and the foreskin. The blisters quickly break leaving rounded or irregular erosions or ulcers which may run together forming a ring of ulceration around the penis.

Sometimes these blisters are accompanied by intense pain, and the pain may precede the development of the blister.

Herpes having once appeared is prone to develop again; at times the recurrence quickly follows the first attack, new crops of blisters forming as fast as the earlier lesions are healed. More frequently there is a distinct interval between the attacks.

The lesions should be kept clean and dusted with thymol iodide. If the condition is very acute a wet boric-acid dressing is useful.

THE PREVENTION OF VENEREAL DISEASES.

The venereal diseases are important in any community because of their prevalence, ready transmissibility, and grave results. A venereal disease that has attacked more than half of the men of the country during youth, a disease that brings misery to thousands of children and suffering to hundreds of thousands of women is a disease to be shunned. A disease that enters the family almost exclusively through promiscuous sexual intercourse, that may be transmitted long after the patient thinks himself or herself cured; that may be transmitted to the wife from the prostitute by the offending husband; that may be passed from the wife thus innocently infected to her child certainly is one to be avoided.

The man who practices promiscuous cohabitation sooner or later contracts one of the venereal diseases in spite of every precaution. *In one way, and one only*, can a man prevent infection with venereal disease, and that is by *absolutely and completely avoiding sexual intercourse* until he marries the woman who is to be his partner through life. Clean living, the indulgence in athletic sports which promote health and occupy the mind, and the avoidance of alcohol during hours of relaxation are important factors in the prevention of venereal disease.

In order to assist those who have not the moral stamina to resist sexual temptation several so-called preventive or prophylactic treatments have been advocated. In reality these are early treatments for venereal disease, as they presuppose the deposition of the infecting organisms on the genital organs or in the urethra. Prominent among the safety measures recommended is the rubber condom, but it may break and so admit infection.

Some measure of safety is afforded by urination and thorough washing with soap and water immediately after cohabitation. To this end the following therapeutic measure adds a far greater assurance of safety if applied soon after intercourse:

Wash the parts well with soap and water, then with a 1-5,000 solution of bichloride of mercury.

Fill the anterior urethra with a 2 per cent solution of protargol by means of a glass penis syringe and retain the solution in the urethra by pressing the lips of the meatus together for five minutes.

Apply a 33 per cent calomel ointment to the penis, rubbing it well into the skin and mucous membrane, paying particular attention to the region about the frænum. It is also advisable to thoroughly anoint the pubic region and entire scrotum, as extragenital infections frequently occur on these parts.

This medication is only reasonably effective if applied within the first hour after coitus. The materials required are not easily carried, so in the Navy this treatment can be administered conveniently to a man only upon his returning to his ship or station. Statistics of venereal infection in the Navy have shown that this treatment is of little value after three hours following exposure to infection.

It has been found that 55.4 per cent of venereal infections are acquired while men are distant from the ship or station—that is, while they are on leave or extended liberty. For this reason medical officers of the Navy are authorized to issue, on request, compound calomel ointment, a preparation that is reasonably effective against gonorrhœa and syphilis, in a form adapted to personal application.

The complete item is made up as follows:

- (a) Outer waxed-paper envelope.
- (b) "Directions for use," printed on thin waxed paper.
- (c) A collapsible container holding 7.5 grams of compound calomel ointment.

The directions for use printed on the waxed-paper are as follows:

DIRECTIONS.

Use IMMEDIATELY After Exposure.

1. (a) Urinate.
- (b) Wash parts with soap and water, if possible.
- (c) In any case, dry parts carefully.
2. (a) Inject into the canal one-half the contents of the tube at once, grasping the lips to prevent escape of the ointment.
- (b) Massage canal for not less than three minutes, so as to spread the ointment over its walls.
- (c) Let the ointment remain until it is necessary to urinate.
3. (a) With remainder of the ointment, anoint the whole length of the penis. Rub in thoroughly, paying special attention to the head and near-by parts.
- (b) Wrap penis in this paper to avoid soiling the clothes.
- (c) Let the ointment remain at least twelve (12) hours.
4. NOTE.—A small amount of ointment rubbed over the penis before exposure helps prevent infection.

While statistics show that the results obtained from this tube are better than with treatment taken after return to the ship or station, the method is by no means infallible and the man who persists in promiscuous sexual indulgence relying on any of these methods of early treatment to prevent infection is sooner or later doomed to disappointment.

REFERENCES.

- | | |
|------------------------------------|---------------------------------------|
| Syphilis.—Hazen. | Urology (2 vols.).—Guiteras. |
| The Practice of Urology.—Chetwood. | Modern Urology.—Cabot. |
| Urology.—Keyes. | Military Urology.—American Red Cross. |

Embalming.¹

All members of the Hospital Corps should be familiar with the procedures necessary in embalming the bodies of the dead and preparing the remains for interment or shipment.

¹ Prepared from section 3, chapter 19, Manual of the Medical Department.

Whenever deaths occur reference should be made to articles 908, 1513, and 1841, Navy Regulations, and chapter 19, Manual of the Medical Department.

All bodies prepared for interment or shipment under the supervision of naval medical officers are thoroughly and completely embalmed in the manner described hereafter, using the embalming fluid as prescribed. If the embalming is done in the United States by a licensed embalmer he may be permitted to use the standard embalming fluid with which he is familiar.

It is incumbent on all Navy embalmers to exercise great care in the preservation of bodies and their preparation for the casket, so that they may reach relatives showing evidence of respectful and careful handling, without signs of decomposition and with the so-called natural appearance preserved.

Shaving and modeling of the features should be completed before beginning the injection. A liberal application of vaseline prevents subsequent drying and is an important matter in respect to the face and hands.

Although recommended as tending to produce a more pleasing appearance of the body and lessening the liability to development of discolored spots and localized collections of gas, it is not necessary to drain the veins of contained blood.

Embalming to be satisfactory requires both arterial and cavity injection.

Arterial injection.

(a) The arterial system shall be injected with an amount of the prescribed embalming fluid equal to 15 per cent of the body weight, estimating 450 c. c. of fluid as 1 pound. (Fig. 166.)

Inject each femoral artery toward toes with 2 per cent body weight.

Inject each brachial artery toward fingers with 1 per cent body weight.

Inject one common carotid artery toward head with 2 per cent body weight.

Inject same common carotid artery toward heart with 7 per cent body weight.

Total amount of fluid, including both femorals and both brachials, 15 per cent body weight.

(b) The technique of injection is important, because prolonged preservation depends upon saturation of every tissue of the body with embalming fluid. To insure uniform distribution it is usually necessary to make all six injections. The return of fluid through the veins while the extremities are being injected will indicate saturation of the extremities, and the return of fluid during the carotid injection upward will indicate sufficient fluid has been injected into the head and upper extremities.

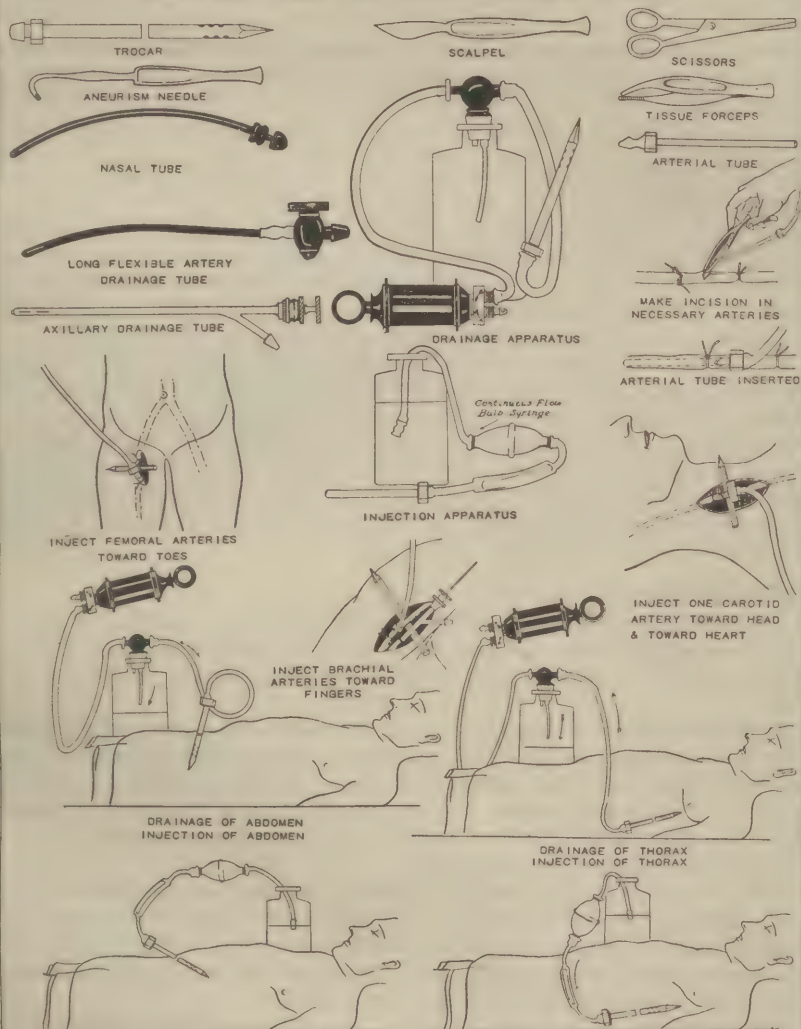
Penetration is promoted by repeated flexion and extension of limbs and by massage of soft parts. An advancing line of firmness of the tissues may be taken as an indication of the progress of the fluid.

It is an easy matter to overinject so that the face and hands are puffy and unnatural. To avoid this two signs may be accepted as indicating that sufficient fluid has been used regardless of the actual amount injected, namely: First, if the eyes, lips, or one side of the face become overdistended, or in the case of an extremity when it is apparent that the fluid has circulated from the smaller arteries through capillaries into veins; and, second, when the tissues of a region are uniformly firm, with no "soft" areas remaining.

Overinjection, however, is not objectionable if a long time is to elapse before the remains are to be viewed, since a slow shrinkage of the body usually takes place.

(c) When the carotids are being injected, massage of the face and adjacent parts is important, it being especially necessary to make sure that the fluid reaches less vascular parts, such as the tip of the nose and margins of the

THE NAVY STANDARD EMBALMING OUTFIT



R LIQUID FORMALDEHYDE 13.5 C.C.
BORAX (SODIUM BORATE) 5.0 GMS.
GLYCERIN (OPTIONAL) 5.0 C.C.
WATER, SUFFICIENT TO MAKE 100.0 C.C.

AMOUNT OF FLUID TO USE IS 15 % OF BODY WEIGHT.
2 % IN EACH FEMORAL ARTERY.
1 % IN EACH BRACHIAL ARTERY.
2 % IN ONE CAROTID ARTERY TOWARD HEAD.
7 % IN SAME CAROTID ARTERY TOWARD HEART.
INJECT THORAX UNTIL SLIGHT EPIGASTRIC FULLNESS IS APPARENT.
INJECT ABDOMEN UNTIL SLIGHT DISTENTION IS APPARENT.

- ① PREPARE EMBALMING FLUID.
- ② ASSEMBLE OUTFIT FOR USE
- ③ INJECT FEMORAL ARTERIES TOWARD TOES.
- ④ INJECT BRACHIAL ARTERIES TOWARD FINGERS.
- ⑤ INJECT ONE CAROTID ARTERY TOWARD HEAD AND TOWARD HEART.
- ⑥ DRAIN AND INJECT THORAX.
- ⑦ DRAIN AND INJECT ABDOMEN.
- ⑧ TIE UP ARTERIES AND SEW UP INCISIONS IN SKIN.

Fig. 166.

ears. Here, as elsewhere, palpable firmness of the tissues is the indication of successful injection. If any of these parts remain soft after completion of the arterial injection and show signs of "skin slipping," fluid should be introduced by means of a hypodermic syringe, the point of the needle being inserted through the ear, hair line, nostril, or mouth, so that the puncture may be invisible.

When, as sometimes happens, it is impossible to attain uniform firmness at the first injection, a second injection undertaken the next day often reaches the soft areas.

Cavity injection.

Besides injection of the arterial system, cavity injection should be performed, as much additional fluid being used for this purpose as may be required. When circumstances permit delay, it is well to postpone cavity injection until several hours have elapsed after the arterial injection has been completed. By that time, if a second arterial injection is to be required, the necessity for it will be apparent, and then it can be undertaken prior to introducing the breaks in the arterial system entailed by cavity injection.

(a) *Thorax*.—By means of aspiration at several points remove all body fluids and inject each pleural cavity with embalming fluid under moderate pressure until a slight epigastric fullness becomes apparent.

(b) *Abdomen*.—By means of aspiration, the point of the needle being extensively moved about, remove as far as possible all gas, liquid intestinal contents, and pathological fluids. Then inject embalming fluid, again moving the needle point about extensively, until slight distention is apparent. Kneading of the abdomen favors diffusion of the fluid.

General instructions.

(a) After autopsy bodies are to be embalmed in the same way; but in such cases the cavities of the abdomen, chest, and skull, after complete removal of all viscera, shall be packed with absorbent cotton saturated with embalming fluid.

(b) If fluid can not be forced into an artery because of clots or other reasons, such as mutilation or advanced decomposition, multiple injections may be made into the tissues, which then should be wrapped in cotton saturated in embalming fluid. In such case, further, the anus, mouth, and nostrils should be plugged with cotton soaked in embalming fluid, and the entire body, including the face, ears, and hair, washed with the fluid.

(c) In the case of a body dead of smallpox, plague, Asiatic cholera, typhus fever, diphtheria, or scarlet fever, the remains, after being washed and after completion of the embalming, shall be bandaged completely, excepting the head, with muslin soaked in embalming fluid. The hands and face shall be enveloped in a suitable cloth saturated with embalming fluid.

Embalming fluid.

(a) The formula for the embalming fluid to be used is given herewith.

Liquid formaldehyde (U. S. P. solution of formaldehyde)-----c. c.	13.5
Sodium borate (borax) -----grams	5.0
Glycerin (optional) -----c. c.	5.0
Water, sufficient to make-----c. c.	100.0

Should the solution of formaldehyde contain less than 37 per cent of formaldehyde gas, the amount used should be increased proportionately.

(b) As this solution is irritating to many skins, some form of protection is advisable. Gloves may be worn in special cases, but in general it will be found more convenient and equally safe to annoint the hands prior to beginning work with a heavy protective ointment.

(c) The exact composition of an embalming fluid is of less importance than the method of injecting it; but service embalmers, who may be acquainted with civilian practice and inclined to follow it, should remember that methods which have proved equal to preserving remains for a few days in temperate regions may be entirely inadequate to preserve bodies for months in the Tropics. The fluid represented by the formula quoted (Francis) will retain its stability for more than 2½ years; it has proved effective in preserving human subjects exposed for two months to a temperature of 98° F.; and the property of formaldehyde in acid solution of bleaching muscular tissue to an ashy gray is overcome by the addition of borax, which furnishes the desired alkalinity without causing deterioration of the solution. This formula is to be used, therefore, in all cases.

(d) The fluid hardens tissues so rapidly that thorough penetration to more remote parts often is hindered. For this reason the whole procedure should be carried out expeditiously, and it is recommended that at each site specified the injection be started with half-strength solution; when the return flow is established the full-strength solution then should be used as directed in this chapter.

(e) The pressure essential to successful injection may be obtained either by elevating the container to a height of 6 feet or by means of a bicycle foot pump. The details requiring attention in employing either method will suggest themselves.

CHAPTER VI.

CHEMISTRY.¹

GENERAL INTRODUCTION.

The study of objects surrounding us constitutes the natural sciences, the larger divisions of which are astronomy, geology, botany, zoology, chemistry, and physics. One would have little difficulty in arriving at the conclusion that the study of a planet came within the realm of astronomy or that when studying plants one was pursuing the science of botany. However, it is not so easy to differentiate clearly between the sciences of chemistry and physics since both treat of the phenomena of matter.

Suppose a stick of sulphur held in the hand is rapidly twirled or thrown through the air. It may be shattered or broken but it still is sulphur; any change occurring is superficial and has to do only with shape or position. Suppose the sulphur is placed in a mortar and finely ground, then fine iron filings added, and the two intimately mixed until a gray colored powder is obtained. If the powder is fine enough, it is possible that the naked eye may not detect the different particles and that the mass will present a uniform and homogeneous appearance, but the mixture is not homogeneous. Should a portion of this mixture be placed beneath the lens of a microscope the particles of sulphur and iron readily can be distinguished from each other. The mixture is therefore heterogeneous; that is, composed of unlike or dissimilar particles and is simply a physical mixture or, as is said in chemistry, a *physical change*. The proportion of either ingredient may be changed at will, either by adding more of one of the ingredients or by the removal of one of those present. By adding carbon disulphide the sulphur can be dissolved from the mixture and poured off, leaving the iron, or by applying a magnet the iron may be withdrawn. Suppose that a part of this mixture of powdered iron and sulphur is placed within a test tube and heated over a Bunsen burner; the mass will fuse, will reach a red heat, and finally will glow brilliantly, and when cooled will present the appearance of a black, hard, fused mass. If a fragment be broken off, powdered, and placed beneath the microscope it will be seen that it presents a homogeneous appearance, all particles being similar. An attempt to remove a portion of the particles with a magnet will fail, and any solvent used will act on all particles alike. Clearly the mass is different from the original powder because the heating of the sulphur and iron together has produced a *chemical change* in which a new substance or compound has been formed. This new compound is called ferrous sulphide and is composed of approximately 35 per cent of sulphur and 65 per cent of iron by weight. These weights are constant and never vary, as is the case in physical mixtures. From this fact the following law has been adduced: "*A chemical compound is always composed of the same ingredients in the same proportion by weight.*" This is

¹Prepared by Chief Pharmacist G. F. Lyon, U. S. Navy.

called the law of constant proportions or Dalton's law. Dalton also discovered the law of multiple proportions which will be discussed later. A law, as the word is used in science, is a statement summing up facts which actually have been found to be true after a large number of experiments have been performed carefully, accurately observed, and verified.

It has been shown by the above that a chemical change differs from a physical one in that, while physical changes are superficial, the changes occurring during a chemical reaction are internal. The whole nature of the reacting substances undergoes a profound change, resulting in the formation of new substances markedly differing in characteristics and properties from those of the original substance or substances. From these facts it must be concluded that *chemistry is that science which treats of the composition of matter, and includes the study of the natural phenomena by which changes due to the influence of chemical energy occur, and the principles involved therein.*

To discover what elements are in any substance and to learn what are the laws governing the actions of elements upon each other is the principal object of chemistry. The process by which the composition of substances is determined is known as *analysis*, and that by which substances are produced by combining elements, is known as *synthesis*.

Physics.

Matter is anything which has weight and occupies space. The different objects about us which may be seen and which come within the above definition apparently are in numbers without end. Yet it has been demonstrated by chemists that there are only about 80 substances known which can not be produced from other substances, or which can not themselves be resolved or divided into two or more substances. These substances are spoken of as *elements*, because they are elemental in nature; that is, they represent the simplest forms of matter. Substances containing more than one element obviously can be resolved into simpler products and therefore are compound matter. Such substances are known as *compounds*.

Matter exists in three states—*solid*, *liquid*, and *gaseous*—and therefore it is not surprising to learn that an element in its natural state may be either a solid, a liquid, or a gas. Some authorities mention a fourth state—*radiant*—and give radium emanations as an example. Solid matter is bounded on all sides, but does not require confinement, liquid matter requires confinement on sides and bottom, while it is necessary to confine gaseous matter on all sides. Many characteristics are possessed by matter, a few of which are *indestructibility*, *divisibility*, *porosity*, and *gravitation*.

Regardless of what physical or chemical change may take place, matter can not be destroyed nor can it be created anew. If a substance is changed physically or chemically it still exists in another form, as has been shown in the mixing of sulphur and iron and the heating of sulphur and iron. The divisibility of matter is that property which permits of its division into small particles, each of which is still the same substance, as in the breaking of the stick of sulphur mentioned above. Porosity is a property of matter in which the particles composing it are surrounded by spaces. That these spaces exist may be shown by mixing equal quantities of water and alcohol, when, instead of having twice the quantity of either the water or alcohol, there is only approximately 97 per cent of the total original quantity of both. This example, while demonstrating certain laws concerning changes in volume of liquids, shows conclusively that the particles of one being smaller than those of the other have fitted themselves into the intermolecular spaces between the larger particles. If they had not, the total quantity after mixing would have been twice the

original quantity of either instead of but 97%. The degree of porosity varies with the density of the substance. Charcoal is very porous, readily permitting the passage of water, and sometimes the spaces or pores may be seen with the naked eye. That even very dense substances are porous is proven by the fact that gases may be forced to pass through thick plates of metal or stone if sufficient pressure is exerted upon them. Gravitation is a common property of matter by which its particles attract other particles, and all masses attract each other. The resistance offered by a substance on being lifted or carried is an example of gravitation, another is the falling to earth of a body thrown into the air. It might be considered that it was the earth alone which exerted attraction in these cases, but most exact experiments have proved that the bodies also exert an attraction for the earth, and the amount of the force of this attraction is directly proportional to the mass of the bodies. The law of gravitation is known as *Newton's Law* and is, that "*All bodies attract each other with a force directly proportional to their masses and inversely proportional to the squares of their distance apart.*"

Mass is any quantity of matter which may be apprehended by the senses and may be either elemental or compound in character. All masses are composed of multitudes of small groups known as *molecules*, which in turn are composed of most minute particles of matter designated as *atoms*. A molecule is the smallest particle of matter capable of existing by itself and retaining its physical characteristics, and is composed of two or more atoms. The atoms of a molecule may be similar as in a molecule of iron or of sulphur, or dissimilar as in a molecule of ferrous sulphide, which contains one atom each of iron and sulphur. Atoms are the smallest indivisible units in which matter can exist, are the smallest particles of matter that take part in chemical reactions, and, as they can not exist in the free state, generally are found in combination with other atoms.

In addition to those properties given above, solid matter, particularly the metals, possesses others which will be briefly described. Most solids resist attempts to force a passage through their particles, due to their *hardness*. When external force is applied, solids easily are broken or fractured, and this is known as *brittleness*. The resistance of solids to attempts to pull their particles apart is called *tenacity*. *Malleability* is a property possessed by solids which permits their being rolled or hammered into sheets. Solids, especially metals, may be drawn into fine strands, and the property allowing this to be done is *ductility*. Another property of matter is *cohesion*.

In studying chemistry the word "force" often is used in connection with the natural phenomena affecting the many chemical and physical changes taking place and described. For this reason the definition of the word "force," and its attendant word, energy, is given here.

Force is the action of one body upon another, or is that which produces, changes, or stops motion. It is a manifestation of energy which may be caused in different ways, as by electricity, heat, and light.

Energy is capacity for doing work and is measured by the work that can be done. The amount of force that can be expended depends upon the energy contained in an atom of the substance doing the work. Energy exists in many different forms as in the motion of masses, in heat, light, electricity, etc., all of which constantly are causing vibration. Energy is of two kinds, potential and kinetic. The energy which is stored in all bodies and capable of being manifested, as that in a drawn bow, is potential energy, and when it is manifested as by the sending of an arrow through space, it is kinetic, that is, actual or moving, energy is exhibited.

That particular property of matter which holds particles of like composition together in a mass so firmly that considerable external force is required to part them is the force of cohesion. (The force of adhesion differs from cohesion in that it holds together bodies of unlike composition, an example being the adherence of a liquid to a solid.) Atoms possess this force of attraction to a degree which holds them together within a molecule. It is possessed by molecules in varying degrees; for instance the molecules of a solid are held firmly together while in liquids the cohesion of the molecules is just about balanced by a repellant force, the result being that the molecules (which are farther apart than in solids) apparently can slide around each other. This fact allows the liquid to assume the same shape as the walls of the vessel which holds it. Molecular attraction is almost wholly absent in either elemental or compound gases, owing to the weak attractive force and the presence of a strong repellant force which causes the molecules to separate as widely as possible. In the study of chemistry this force generally is spoken of as *chemical affinity*, which is defined as *the power of attraction that an atom of one element may have for an atom of some other element, binding them together to form a molecule*. Atoms of some elements may possess marked affinity for each other, and have little or no affinity for atoms of other elements, while a few elements are known which seem to have no chemical affinity and form no compounds. Thus pure hydrogen and chlorine, in the presence of even weak sunlight, will unite with almost explosive violence, while under no conditions has a union of oxygen with fluorine been accomplished. Generally speaking, it may be said that an element of positive quality will have a much greater affinity for an element of negative quality than it will have for an element of positive character. It follows that the converse is likewise true. Oxygen is a noted exception, since it will unite readily with all known elements except fluorine and the elements of the argon group. The members of the argon group seem to possess no affinity for any known element and all efforts to combine any one of them with other elements have failed. Chemical reactions between elements depend primarily upon affinity, and if there is none, chemical change can not take place. Other factors which increase or limit the degree of completion to which a reaction can go and the speed with which it may be consummated are heat, light, electricity, catalytic agents, and pressure.

Atomic weight.

Atoms of the same element always possess the same weight in relation to any definite standard selected with which to compare them, but the weight of an atom of one element is never the same as that of an atom of any other element. Atomic weight of course is purely relative, as it is impossible to weigh single atoms, and is of service only when compared to the weight of a definite standard. For a great many years hydrogen, since it is the lightest of all known elements, was used as the standard for atomic weights and its atomic weight arbitrarily was placed as 1, but hydrogen is very difficult to obtain in a pure state and mistakes as to its actual weight frequently occurred. Each time an apparatus or process was developed which came a little nearer to obtaining pure hydrogen, and consequently nearer the determination of its true weight, a revision, entailing recalculations of the atomic weights of all other elements, became necessary. This caused much work and finally the use of hydrogen as a standard was discontinued and oxygen substituted. Under the old system the atomic weight of oxygen was 15.88 but in the new system was fixed at 16. Thus when it is stated that the atomic weight of

sulphur is 32, it is meant that the weight of an atom of sulphur bears the same relationship to the weight of an atom of oxygen as 32 bears to 16, and similarly, since the atomic weight of iron is approximately 56, the relationship between the atomic weights of iron and of oxygen is as 56 is to 16.

Molecular weight.

The weight of a molecule is the sum of the weights of all atoms which compose it. A molecule of hydrochloric acid is composed of an atom of hydrogen and an atom of chlorine. The atomic weight of hydrogen being 1.008 and the atomic weight of chlorine 35.46, the molecular weight of hydrochloric acid is the sum of 1.008 and 35.46, or 36.468, and the relationship of the molecular weight of hydrochloric acid is to the atomic weight of oxygen as 36.468 is to 16.

NOTATION.

Chemical symbols.

For convenience in working out chemical equations, and in representing the results of chemical action, abbreviations of the names of the elements, called symbols, are used. These symbols have become fixed by long usage and usually consist of the first letter of the name of the element they denote, as O for oxygen, H for hydrogen, N for nitrogen. As some elements have names beginning with the same letter some other letter of the name is added, as Fe for iron, Cu for copper, Hg for mercury, Mg for magnesium. When used in connection with the expression of a chemical formula the symbol represents more than just the name of the element; it represents a definite quantity of that element, an atom, and since atoms have weight, it also represents a definite weight of the element. As atoms are the smallest particles of matter there can be no subdivision of them and they must occur as one or in multiples of one. When necessary to express more than one atom the symbol is written, and a little below and to the right the proper numeral is placed; thus, four atoms of iron would be written, Fe_4 . Similarly Cl_6 and Hg_2 represents six atoms of chlorine and two of mercury, respectively.

Of the known elements there are only about 20 of sufficient importance to a hospital corpsman that any particular study should be made of them at this time. All arrangements of elements by classes for purposes of study, or otherwise, are arbitrary. However, it is believed that the arrangement given in Table II will be of assistance in remembering the valence and separating the positive elements from the negative. The characteristics of the positive and negative groups are quite different. The members of the positive group are base formers, while the members of the negative group are acid producers. It is quite necessary, in order to understand why a certain chemical formula represents a specific compound, and to be able to write the correct formula for a compound when named, that the symbols and valencies of all the elements given in Table II be thoroughly learned. Also, in order to facilitate the calculations of reacting weights, a thorough knowledge of the approximate atomic weight of these same elements, as given in Table I, likewise should be acquired. For this reason it is recommended that the whole of Table II be memorized before proceeding further with the study of this chapter.

Chemical formulas.

A *chemical formula* is a group of symbols showing the kinds and amounts of elements contained in a compound. A formula standing alone represents one molecule of the substance. A symbol of an element contained in a molecule represents one atom of that element. If more than one atom is

present in a molecule, the proper small numeral is written in, as explained above. If it is desired to express more than one molecule, a large numeral is written before the formula. This large numeral multiplies everything within the formula, much the same as a multiple of an algebraic quantity is expressed, for example: H_2O is the formula for water, and as written represents one molecule of that compound, while $2\text{H}_2\text{O}$ represents two molecules. To be correct a chemical formula must balance. It has been learned that oxygen has a valence of II while the valence of hydrogen is I. Manifestly one atom of hydrogen is not the equivalent of one atom of oxygen in combining power, and if the two are combined it will require two atoms of hydrogen to balance or equalize one atom of oxygen, as in any given compound all valencies of each atom must be employed; that is to say, no element may have a free valence in any saturated compound. The valence of barium is II, and therefore one atom of barium can unite with one atom of oxygen to form a molecule of barium oxide. If the valence of one element of a compound is a multiple of the valence of the other element in the compound, take the symbol of the element with the lower valence as many times as it is contained in the valence of the other element and write the quotient as the exponent of the element with the lower valence as directed before. To write the formula of silicon oxide and have it balance, silicon having a valence of IV and oxygen II, the symbol of oxygen must be multiplied by 2. The formula of silicon oxide, therefore, is SiO_2 . If the valencies of the two elements concerned are not equivalent and are not multiples of each other, write the symbols side by side and take each symbol as many times as the other has valencies. The valence of aluminium is III, and one atom of that element is not balanced by one atom of oxygen with a valence of II, so to write the correct formula of aluminium oxide it is necessary to take the symbol of aluminium twice and the symbol of oxygen thrice, which gives the formula Al_2O_3 . This is the simplest arrangement in which the two can be combined to form a compound.

Chemical formulas are of four kinds, which are named and described as follows: *Empirical formulas* show the quality but not the quantity (other than relative) of compounds, as in $(\text{C}_6\text{H}_{10}\text{O}_5)_x$, the formula of starch; but when some special arrangement of the atoms of the substance is made to show not only the quality and quantity of the elements in a compound but the relationship between the different elements or groups of elements they are known as *rational formulas*, an example of such an arrangement being $(\text{OH})_2\text{SO}_2$ the formula of sulphuric acid. *Graphic* or *structural formulas* are those in which the relative position of the atoms is shown as a picture, the exact linking of the atoms being given with the symbols of the elements entering into the compound. Graphic formulas are shown on page 360. *Stereochemic* formulas are used in the study of such advanced chemistry that they will not be discussed.

In order to understand the use of chemical formulas, especially graphic formulas, a knowledge of the combining power of elements, which is based on that of the atoms of the element, is necessary.

VALENCE.

The combining power of an atom of an element is known as *valence*. It sometimes is spoken of as the saturating or replacing power of an element. Hydrogen is taken as the standard in fixing the valuation of valencies, and its valence arbitrarily is designated as one. In some elements valence is comparative, because they will not combine with hydrogen, as mercury, for instance. The valence of such elements is determined by comparison of the combining element

with one which will combine with hydrogen. Therefore, as one atom of mercury will combine with one of oxygen, and it is known that one oxygen will combine with two hydrogen, the valence of mercury is said to be two. If an element has such strength, or valence, that it can unite with two atoms of hydrogen, it is said to have a valence of two. If it can unite with four atoms of hydrogen its valence is four, etc. Elements often are designated as being univalent, divalent, trivalent, or tetravalent, respectively, when their atoms are possessed of one, two, three, or four valencies. Similarly, they may be designated as monads, diads, triads, tetrads, etc. The valence of an element may be indicated also by Roman numerals placed to the upper right hand of the symbol. A hexad atom can unite with and completely neutralize six atoms of a monad, three atoms of a diad, two atoms of a triad, or one atom of a hexad. An atom of a tetrad could unite with four atoms of a monad, two atoms of a diad, or one atom of another tetrad. Furthermore, any triad, tetrad, etc., atom may neutralize several different kinds of atoms of lower valence at one and the same time. For example, a hexad may unite with one triad, one diad, and one monad, or with any other combination of atoms the sum of whose valencies does not exceed six.

Valence may be likened to men having as many hands as elements have valencies and each hand ready to grasp the hand of another person and form a bond. Sometimes, as shown above, one hand may be so strong that it takes more than one of the other's hands to hold the grip which forms the bond.

Polyvalence.

Certain elements may possess more than one valence. An atom of mercury, for instance, under some circumstances, will combine with one atom of chlorine, forming mercurous chloride, commonly known as calomel, and under other conditions it will combine with two atoms of that element to form mercuric chloride, popularly but erroneously called bichloride of mercury. Just why an element may possess this quality of polyvalence is not known. It only is known that they do possess it.

When an element changes its valence, either higher or lower, the change usually is in degrees of two, changing from monad to triad, diad to tetrad, etc., or the reverse. Exceptions to this rule are known, however, as iron, which changes its valence 1 degree at a time, as from a valence of 1 to a valence of 2, and from 2 to 3.

That these varying valencies may be indicated, the terminations *ous* and *ic* are used, denoting the lower and higher valence, respectively, as cuprous oxide, Cu_2O , in which copper has the valence of 1, and cupric oxide, CuO , in which copper has the valence of 2.

When all the valencies of an element are satisfied or hooked up with others a compound is said to be saturated. In some compounds it is believed that valencies for which there is no satisfying valence may hook up with each other, although this is not known positively. For instance, in ammonium chloride, NH_4Cl , it is known that nitrogen acts as a pentad and has all valencies satisfied, while in ammonia gas, NH_3 , it is known that nitrogen acts as a triad having 3 valencies satisfied. The fact that by adding hydrochloric acid to ammonia gas, ammonium chloride is produced, with the consequent increase in valence from 3 to 5, and the knowledge of similar occurrences in other compounds, has led to the belief that possibly the unsatisfied valencies unite with each other in compounds which otherwise would not be saturated.

Valence also is indicated by using the symbol of the element with bonds, or arms, as they might be called, equal to the degrees of valence extending from

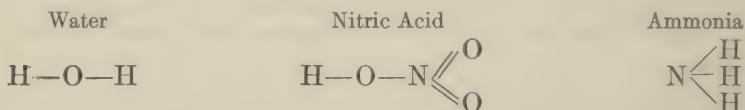
it. It is not necessary that these bonds be attached to the symbol in any definite position, but only the proper number of bonds corresponding to the degree of valence may be used. To illustrate the above the following examples are given showing the placing of the required number of bonds about the symbol of the element and the name of the degree of valence:



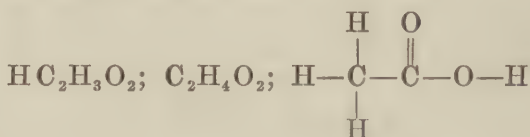
Different positions of bonds.



Practical use of graphic formulas to show the composition of compounds is obtained by linking the bonds of the symbol of one element with those of others, so that all bonds are joined, always remembering that only one bond of an element ever can be linked with one bond of another atom. Some examples of common compounds written graphically are:



To show how the formula of a compound may be written, acetic acid can be represented in any of the following ways:



NOMENCLATURE.

To be a compound a substance must be composed of atoms of two or more elements. The naming of chemical compounds depends on a system in which certain accepted terminations are added to the name of one of the elements in the compound. These terminations are considered as meaning that nothing but the elements specifically named is present in the compound. For compounds containing only two elements or one element and a radicle the termination *ide* is used; compounds formed in the union of oxygen, sulphur, chlorine, etc., with another element or radicle are known as oxides, sulphides, chlorides, etc., respectively.

In addition to this termination there are other ways of distinguishing compounds, each of which indicates a compound formed by the combination of elements in different proportions. Copper oxide is the proper designation of both the cuprous and cupric salts of copper, for they contain only two elements, but they are different bodies. Therefore the cuprous salt is designated as copper *suboxide* and the cupric salt as copper *monoxide*. *Sub* is used to indicate a difference in the normal combination of the elements in a salt and in this case there is less oxygen in combination with copper than there is in copper mon-

oxide. *Mon* is but one of the several syllables used to designate the relative quantities of elements which combine in more than one proportion, the others, with examples, being: Carbon *dioxide*, CO_2 ; sulphur *trioxide*, SO_3 ; carbon *tetrachloride*, CCl_4 ; and phosphorous *pentachloride*, PCl_5 , etc. Occasionally a compound has one-half more of an element than another compound containing the same elements, or the proportion is as 1 to $1\frac{1}{2}$. But as fractions are not allowed in formulas the whole expression is multiplied by two and the proportion becomes as 2 to 3, and such compounds are known as *sesqui*-compounds, the word *sesqui* meaning one and a half. The formula of iron-sesquioxide, therefore, instead of being $\text{FeO}_{1\frac{1}{2}}$ is Fe_2O_3 .

Other syllables and terminations used in the naming of compounds will be explained during consideration of acids, bases, and salts (these being the principal representatives of ternary compounds), those which have been given above being used almost entirely in binary compounds.

Binary compounds are those in which the molecules are made up of only two different elements, as water, H_2O , potassium iodide, KI , or calcium oxide, CaO . A molecule of a *ternary compound* contains atoms of three or more different elements, as potassium chlorate, KClO_3 , magnesium sulphate MgSO_4 , or sulphuric acid, H_2SO_4 . Ternary compounds are considered as being first derived from binary compounds.

ELECTRICAL PROPERTIES OF THE ELEMENTS.

Before proceeding further, it is necessary to discuss electricity and its relation to the elements, as many conditions existing and changes occurring are directly concerned with this natural phenomenon.

Electricity usually is spoken of as static and dynamic. Static electricity is the form which remains stationary until activated by friction, while dynamic electricity is the electricity of action, producing power, heat, and light.

Two conditions are exhibited by electrical excitement and are known as positive and negative. The points in any apparatus developing electricity at which these conditions are manifested are called poles or electrodes, and they further are designated as positive and negative from the character of the electricity discharged from them. These points may be distinguished also by the sign $+$ for the positive or anode pole and the sign $-$ for the negative or cathode pole.

It is a well-known law that similar or like electricities repel each other and dissimilar or unlike electricities attract each other and that bodies charged with positive or negative electricity act in the same manner. From knowledge of this law has developed a practical application of its principles in determining many important relations between elements. This is known as *electrolytic dissociation* or *ionization*.

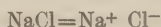
The experiments conducted to determine the relations of electricity to chemistry have shown that elements contain electrical charges, some being positively charged and others negatively. Generally these experiments have been carried out on solutions of substances made up of known elements in water, contained in vessels known as "decomposing cells." In these cells are placed the electric terminals (electrodes or poles) of the apparatus producing the electricity. Thus if a current of electricity is passed through a solution of hydrochloric acid in water, chlorine is given off at the positive or anode pole and hydrogen at the negative or cathode. Water, when pure, does not conduct electricity appreciably, but solutions of acids, bases, and salts, which are compounds of elements, conduct electricity readily. In doing so, however, it involves the breaking up of the substances dissolved which is known as *electrolysis*, and substances whose aqueous solutions conduct electricity are known as *electrolytes*. There are substances which do not conduct

electricity, such as organic bodies like sugar, starch, and albumin, and these are known as *nonelectrolytes*.

In connection with ionization is a natural phenomenon known as *osmotic pressure* in which solutions of the same substance but of different strengths when brought in contact with each other gradually are entirely mingled as the result of one solution pushing its way into the other. If a bladder, which is a semipermeable animal membrane is filled with a mixture of alcohol and water, tied tightly, and immersed in water, it will slowly swell until it bursts. This is due to the fact that water can pass through the pores in the membrane but the alcohol can not, and consequently the bladder finally becomes so full that it ruptures. Experiments conducted have shown that electrolytes possess osmotic pressure in a higher degree than nonelectrolytes. Chemists finally decided that, because of certain facts determined in the course of their investigations, a modification of the molecules in solutions of electrolytes took place by the mere act of solution, in which two groups were developed from each molecule, one positively charged and the other negatively. These groups were termed *ions* and the conditions bringing about their formation *ionization* or *electrolytic dissociation*.

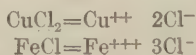
It has been shown how molecules of electrolytes, when dissolved in water, break up into independent particles called "ions" charged with positive or negative electricity. The properties of such a solution are fixed by the nature and numbers of these particles that are present but their formation does not require the presence of electric current. Those which are charged with positive electricity are attracted to the negative pole and those charged with negative electricity are attracted to the positive pole. These ions move about in the solution just like independent molecules. From this fact comes the name "ion," a Greek word meaning to go, to wander. Positive ions are indicated by the sign $+$ placed above the symbol of the element, or above and to the right, and negative ions by the sign $-$.

The ion differs from an atom or molecule in that it carries a charge of electricity. This electrical charge modifies greatly the usual chemical action of the element, and secondary reactions sometimes occur between the liberated ions and the liquid around the pole or even with the substance of the pole itself. If an electric current be passed through an aqueous solution of Na_2SO_4 (sodium sulphate), it would be expected that in dissociation sodium would be liberated at one pole and the group SO_4 at the other. However, what actually occurs is: The sodium attacks the water and caustic soda (NaOH) is formed, while hydrogen is liberated. Then the group SO_4 reacts with the water (H_2O) and we have H_2SO_4 (sulphuric acid) with oxygen liberated. Sodium as an ion differs from ordinary sodium in its properties. It has been explained that in the dissociation of any molecule two kinds of ions are formed, one positive and the other negative, and *the sum of the positive charges is always equal to the sum of the negative charges*. Thus, in the dissociation of NaCl we have:



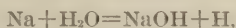
Therefore the solution is electrically neutral, the positive Na ion just equaling the negative Cl ion.

If we have divalent radicles, on dissociation they will become ions carrying a double charge. So also trivalent ions will carry a triple charge. Examples are:

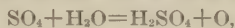


In the above the coefficients two and three multiply the charges as well as the radicals themselves, so that the number of positive and negative charges are equal.

In the electrolysis of sodium sulphate a solution of Na_2SO_4 gives the ions $2\text{Na}^+ \text{SO}_4^{2-}$. The sodium atoms when discharged decompose the water about the cathode pole thus:



The SO_4 ions when discharged at the anode pole decompose the water thus:



and new substances have been formed at the cathode and anode poles.

Many modern chemists hold the ionic theory to be untenable, giving as reasons certain phenomena that are too involved to explain here, but the theory of ionization generally is accepted.

In closing this subject concerning the electrical nature of the elements it may be said, approximately, that the metals are all positive and the non-metals negative. This is only partially true, and, moreover, while an element may be classed usually as positive or negative it might under certain conditions exhibit certain functions of the opposite group. Thus zinc and aluminium are both classed as metals and are generally quite positive in character, yet under certain specific conditions they will act when brought into contact with a stronger and more basic metal much as a negative or nonmetal would under the same circumstances.

REACTIONS AND EQUATIONS.

In chemistry these terms are synonymous in so far as their use is concerned. It has been shown how chemical symbols are used to indicate the composition of a substance, and chemical symbols are used further to show exactly the nature of the chemical changes which occur when different substances come in contact with each other. The grouping of the symbols in this manner is called a *reaction*, but, strictly speaking, the statement is an "equation of the reaction," as it is written in the form of an equation and both sides of the equation must balance. It is customary to speak of these expressions either as reactions or equations. The signs of addition, +, and equality, = or \rightarrow , are used in expressing the reaction, but as the reaction may be reversible the use of the words "results in" or "produces" is preferred to "equals."

By the use of chemical symbols a chemical equation may be described as a shorthand method of recording what has happened in a chemical reaction and obviously must be a statement of facts that actually occurred. In other words, the equation is written to fit the reaction, and consequently equations can not be written until it is known through testing and experimenting exactly what has happened in any given instance. The general laws of chemistry and physics and observations of large numbers of reactions have been studied until it is known just what will happen in the majority of cases where specific reagents (compounds used for producing reactions) are brought in contact.

In writing reactions or equations, three difficulties usually are encountered. These difficulties are to know if a given change will occur, to know the amount of the substance to be used, and to know the character of the substance formed in the reaction. The first difficulty is experienced because the varying electrical natures of the elements affect their affinities, and the disturbing of ordinary affinities by the formation of insoluble bodies when liquid substances capable

of producing them are brought together, the facility with which bodies that can be volatilized or converted into a gas diminish in their chemical power when this occurs, and the proportion or concentration of the substances brought in contact with each other. The second difficulty met with is caused by the necessity of knowing the ratio in which the substances can react upon each other, and is determined by their valencies. The third difficulty encountered is due to the electrical relations of the ions of the substances coming in contact with each other, in which it is necessary to remember that electro-positive ions can unite only with electro-negative ions. Reactions may be the result of four factors, which are:

(1) Direct combination, as, iron and sulphur when heated unite to form ferrous sulphide. $\text{Fe} + \text{S} \rightarrow \text{FeS}$.

(2) Simple decomposition, when a compound is decomposed or broken up into simpler substances, as, calcium carbonate when heated, breaks up into calcium oxide and carbon dioxide. $\text{CaCO}_3 + \text{Heat} \rightarrow \text{CaO} + \text{CO}_2$.

(3) Substitution, or displacement, when an element replaces one of those present in a compound, as, when zinc replaces the hydrogen in sulphuric acid forming zinc sulphate and hydrogen. $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + 2\text{H}$.

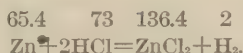
(4) By double decomposition when all the reacting compounds are decomposed and entirely new compounds formed, as, calcium hydroxide and hydrochloric acid react to form calcium chloride and water. $\text{Ca}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$.

When dealing with reactions generally between acids and metals, or metallic oxides or hydroxides, it is safe to assume that a salt of known content will be formed; for example, when zinc is placed in a solution of hydrochloric acid it is known that zinc chloride will be among the products formed and that hydrogen will be another product.

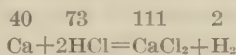
It is very much simpler to write the equation $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$ than it is to write a statement that an atom of zinc plus two molecules of hydrochloric acid will produce a molecule of zinc chloride and a molecule of hydrogen (or two atoms of hydrogen), as the equation expresses the same facts and more.

It was learned that the atoms of all the elements possess weight and that this weight is comparable to the weight of an atom of hydrogen. It therefore follows that if an atom of zinc and two molecules of hydrochloric acid will produce a molecule of zinc chloride and a molecule of hydrogen, a definite weight of each of the former must produce a definite weight of each of the latter, since, through the law of the conservation of mass, it is learned that no matter, or weight, is lost or gained in any chemical reaction. The actual weight of any atom is not known, but the relative weights are; therefore, let the atomic and molecular weights of the elements and compounds involved in the above equation be placed in the proper position just above the equation and observe the result. Zinc has an atomic weight of approximately 65.4, and as only one atom of that element is involved in this equation that figure is placed above the symbol of zinc. The atomic weight of hydrogen is, roughly, 1, and of chlorine 35.5. The molecular weight of hydrochloric acid therefore is 36.5, but as that figure represents the weight of only one molecule and in this equation two molecules are involved, the number is doubled and the number 73 placed above the formula of hydrochloric acid. The molecular weight of zinc chloride must be the atomic weight of zinc (65.4 plus twice the atomic weight of chlorine $(35.5 \times 2 = 71)$ or 136.4), which is written above the formula of that compound,

and 2, of course, is the molecular weight of hydrogen. The equation then appears as follows:



As no weight may be lost or gained in a chemical reaction, the combined weights of zinc and hydrochloric acid should just equal the combined weights of zinc chloride and two atoms of hydrogen, and it is found that they do, the sum of the weights of the elements and compounds on either side of the equality sign being 138.4. Now, irrespective of what the actual weight of the atoms or molecules may be, this equation shows that 65.4 parts by weight of zinc and 73 parts by weight of hydrochloric acid will produce 136.4 parts by weight of zinc chloride and 2 parts by weight of hydrogen. One may substitute any unit of weight desired—grains, ounces, tons, kilograms, or grams—for the word “part” and the actual weights involved read off as such. If a chemical equation is written correctly, the combined weights of the reacting substances will exactly equal the combined weights of all the products. It naturally follows that if a compound is formed which contains more atoms of an element, or requires two or more radicles to balance it, and those amounts are not contained in one molecule of the substance from which it is to be supplied, more molecules of that substance must be used. In other words, enough of the substance must be used to supply the amounts needed. Suppose metallic calcium is dropped into some hydrochloric acid. It is known that calcium chloride (CaCl_2) will be formed, the equation being:



Since a molecule of calcium chloride contains two atoms of chlorine and one molecule of hydrochloric acid contains only one atom of chlorine, it is necessary to use two molecules of that acid. Determining the weights involved in the above equation, we find that 111 parts of calcium chloride and 2 parts of hydrogen are formed by the action of 73 parts of hydrochloric acid on 40 parts of calcium, all parts being by weight.

By applying the above principles the weights of any substances required to produce a definite weight of a specific compound may be calculated. First the equation must be stated and balanced, next the reacting weights must be written in their respective places above the equation, and then, by making a simple statement in proportion, the required weights easily are ascertained.

Suppose the problem is to ascertain the quantity of hydrochloric acid necessary to produce 75 grams of calcium chloride. By reference to the preceding equation it is noted that 73 grams of hydrochloric acid will produce 111 grams of calcium chloride. It follows, then, that:

$$73 : 111 :: x : 75$$

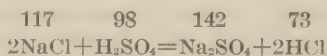
wherein it is found that x equals $49.32 +$ grams of hydrochloric acid. Similarly, had the problem been to determine how much calcium chloride could be made from 1.850 grams of hydrochloric acid the statement would have been:

$$73 : 111 :: 1.850 : x,$$

and x would equal $2.813 +$ grams of calcium chloride.

The weights expressed in the foregoing equations are for 100 per cent, or absolute compounds, which are compounds with absolutely no diluents or impurities present. Unfortunately such compounds rarely are met with in practice, so that when dealing with actual cases it generally is necessary, after

determining the required weights of the absolute substance, to calculate how much of the impure or diluted product at hand will be necessary to furnish the required amount of absolute substance. In dealing with liquids the specific gravity, in addition, must be taken into consideration. Suppose the problem is to determine how many c. c. of a solution of sulphuric acid, specific gravity 1.90, 90 per cent by weight, will be required to liberate 1.125 grams of hydrochloric acid from the appropriate quantity of sodium chloride. The equation is written and the reacting weights calculated. Using approximate atomic weights, this would be as follows:



which shows that 98 grams of absolute sulphuric acid will produce 73 grams of absolute hydrochloric acid. Then,

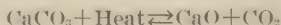
$$98 : 73 :: x : 1.125$$

and x is found to equal $1.510 +$ grams.

Now, the specific gravity of the solution of sulphuric acid to be used is 1.90, therefore 1 c. c. will weigh 1.9 grams (volume \times sp. gr. = weight), of which 90 per cent, or 1.71 grams, is absolute sulphuric acid. Then, if 1 c. c. contains 1.71 grams of absolute acid and 1.510 grams of the absolute acid are needed, by dividing 1.510 by 1.71 the required number of c. c. is ascertained, which is, in this case, $883 +$.

It also will be observed that many compounds are crystalline in character, and in these crystals the compounds are combined loosely with one or more molecules of water (water of crystallization), and the weight of this water, though it may be driven off by heating the crystal, must be taken into consideration when the crystals themselves are used. The molecular weight of sodium carbonate, for instance, is, in round numbers, 110, but crystals of this compound can not be indicated always as Na_2CO_3 . In one official salt the compound exists as $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$; therefore to obtain 110 grams of the absolute salt in this case it will be necessary to weigh out 286 grams of the crystals of that compound.

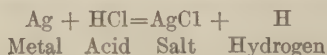
Reversible reactions.—It has been previously stated that the degree of completion to which a reaction may proceed and the speed of the reaction are contingent upon certain factors which were named. Therefore, to a certain extent, a reaction may be controlled partially and in some cases they may be made to proceed in either direction; that is, the products under suitable conditions will produce the original substances. Such reactions are said to be reversible. The reaction between calcium oxide and carbon dioxide is of this nature, for, if a stream of carbon dioxide is allowed to pass over calcium oxide, calcium carbonate is produced; while if calcium carbonate is heated, that compound is decomposed into calcium oxide and carbon dioxide. Such a reaction is written as follows:



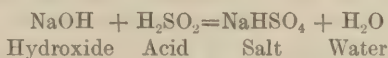
This equation simply means that the reaction may proceed from left to right, or vice versa, according to the conditions obtaining at the time. (See Law of Chemical Equilibrium.)

In connection with the writing of equations showing reactions, the following rules, with examples, are given to assist the student.

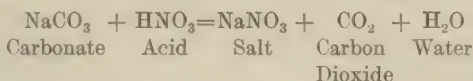
(1) Any metal plus any acid gives a salt of the metal plus hydrogen. Example:



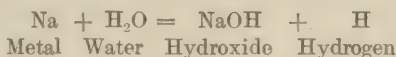
(2) Any hydroxide plus any acid gives a salt of the acid used plus water. Example:



(3) Any carbonate plus any acid gives a salt of the acid used plus carbon dioxide plus water. Example:



(4) Any metal plus water which produces a reaction gives a hydroxide of the metal plus hydrogen. Example:



RADICLES.

Combinations of elements which act as elements are radicles. Another way of defining radicles is by saying that they are groups of atoms having unsatisfied valency. These combinations remain together and act as a single element, but can not exist in the free state. They always are found in combination with other atoms, although they may act in every way as single atoms in chemical reactions. The valency of radicles is determined by the number of valencies unsatisfied, and is known as saturated, (CH_4) , monad, (CH_3) , diad, (CO) , etc. With but few exceptions the names of radicles terminate in *yl*, as hydroxyl, carbonyl, methyl, etc., and they are identified in chemical formulas by enclosing them in brackets or parentheses, as $\text{Fe}(\text{OH})_3$, instead of FeO_3H_3 . In addition to being known as a radicle such a group of atoms may be known as a residue; that is, what remains after the removal of an atom from a saturated molecule.

The formulas, valencies, and names of some of the more important radicles are given in the table below.

Formula.	Name.	Valency.	Formula.	Name.	Valency.
NH_4	Ammonium.....	Monad.	CH_3	Methyl.....	Monad.
NH_2	Amidogen.....	Monad.	CN	Cyanogen.....	Monad.
OH	Hydroxyl.....	Monad.	CO	Carbonyl.....	Diad.

Although generally referred to as the sulphuric and sulphurous radicles, the groups SO_3 and SO_2 are really anhydrides, which are compounds derived from acids by the abstraction of a molecule of water. Literally, anhydride means "without water."

Radicles play a most important part in the various reactions of analytic and synthetic chemistry, readily interchanging with atoms in chemical reactions. Radicles are so closely interwoven in the theories and laws concerning the formation of acids, bases, and salts that consideration of them will be continued in the discussion of:

ACIDS, BASES, AND SALTS.

Any one of these three different kinds of compounds in turn may be either a binary or ternary compound.

Acids are compounds of an electro-negative element, or group of elements, with hydrogen. They may, or may not, contain oxygen. Acids neutralize

(nullify) alkalies, destroy or change the color of litmus or other indicators, are sour to the taste and have a corrosive action on animal and vegetable tissues. Through their action on metals hydrogen is liberated from the acid, the metal taking its place and forming a salt.

There are two important classes of acids which are known as binary, hydrogen, hydro, or halogen acids, and ternary, oxy, or oxygen acids. Examples of each are shown below.

Hydrogen acids.		Oxygen acids.	
HCl.....	Hydrochloric acid.	H ₂ SO ₄	Sulphuric acid.
HBr.....	Hydrobromic acid.	HNO ₃	Nitric acid.
HI.....	Hydriodic acid.	H ₃ PO ₄	Phosphoric acid.
HF.....	Hydrofluoric acid.	H ₂ CO ₃	Carbonic acid.
		HClO ₃	Chloric acid.

The strength of an acid is said to depend upon the degree to which it can dissociate or ionize. When an oxide of a negative element is dissolved in water an acid is produced. Theoretically, then, in order to manufacture an acid the first step is to produce an oxide of the element. Such an oxide is known as an acid anhydride, which may be described as an acid from which all hydrogen with sufficient oxygen to form water has been removed. For purposes of nomenclature all ternary acids are considered to be derived from acid anhydrides.

A molecule of an acid may be said to be composed of two parts—its replaceable hydrogen and the remainder of the molecule. This remainder is known as an acid radicle or residue. If an acid contains one atom of hydrogen to a molecule, as does hydrochloric acid, one atom of any univalent element may replace that hydrogen to form a normal salt, but as an atom of a divalent element is the equivalent in strength, or valence, to two hydrogen atoms one divalent atom can replace the hydrogen contained in two molecules of such an acid. Conversely, if the acid contains two atoms of replaceable hydrogen to a molecule, as sulphuric acid, it is evident that it must require two atoms of a univalent element, or one atom of a divalent element to replace it. For that reason radicles are regarded as groups not broken up easily, which act as a unit in most reactions, and which possess valence (or basicity) the same as do elements, this basicity being controlled by the number of replaceable hydrogen atoms in a molecule of the acid of which they are the residue; for example:

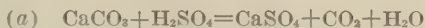
Acid.	Radicle.	Basicity.
HNO ₃	—NO ₃	1
HClO ₃	—ClO ₃	1
H ₂ CO ₃	=CO ₃	2
H ₂ SO ₄	=SO ₄	2
H ₃ PO ₄	≡PO ₄	3
H ₃ BO ₃	≡BO ₃	3

The formula for a radicle may be written correctly and no attention paid to the valence of any particular element in it, since these elements are acting as a group, or whole, and, as stated above, the valence or basicity of the radicle or group is governed solely by the number of replaceable hydrogen atoms originally combined with them in the acid of which they are the residue. Observing the matter in this light, it is clear that by knowing the valence of the base

to be used and the formula of the acid from which the radicle is derived, the two then may be combined exactly in the same manner as would be two elements to form any binary compound. For example, it is desired to write the formula for zinc carbonate. Zinc has a valence of two. Its symbol, Zn, is written down. A carbonate must come from carbonic acid, since carbon is the characteristic element in that radicle and "ate" salts come from "ic" acids. The formula for carbonic acid is H_2CO_3 . The carbonate radicle therefore must be CO_3 and is written down alongside and next after the symbol for zinc. Carbonic acid, containing two atoms of replaceable hydrogen to a molecule, shows that the carbonate radicle must be dibasic and accordingly will exactly match in valence strength with one atom of zinc. The formula for zinc carbonate therefore is ZnCO_3 . In other words, zinc being divalent, is equal in combining power to two hydrogen atoms and can replace them in any acid. Sodium is univalent, and it would require two atoms of that element to replace all the hydrogen in a molecule of carbonic acid, so that the formula for sodium carbonate would be Na_2CO_3 . Whenever a whole radicle must be used in a formula more than one time (unless it is a binary radicle) it is necessary to enclose it within parentheses and multiply it by using a small numeral suffixed somewhat below the parentheses, as is done in the case of multiplying a single atom. For example—

Calcium chlorate----- $\text{Ca}(\text{ClO}_3)_2$
 Ferric sulphate----- $\text{Fe}_2(\text{SO}_4)_3$
 Ferrous phosphate----- $\text{Fe}_3(\text{PO}_4)_2$

Carbonate radicles generally are broken up when brought in contact with an acid or when heated, and therefore when a carbonate reacts with an acid another carbonate is not formed, but carbon dioxide and water are among the products. This is shown by the equation marked (a) below. When heated all carbonates except those of the alkalies will produce carbon dioxide and an oxide of the element with which it is combined as a carbonate, as shown by the equation marked (b).

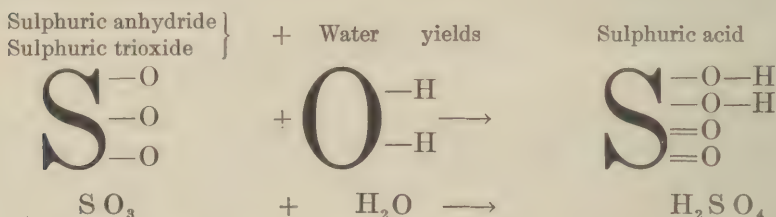


In order to become familiar with writing formulas it is suggested that they be written whenever possible until one is able to set down without error the formula for any salt that might be formed from the union of any positive element given in Table II with any acid listed in Table III. Many such possible combinations do not actually exist, but the mere setting down of the formulas for such hypothetical compounds can do no harm, and the practice so obtained should prove most beneficial. Here let it be said that very few salts actually are formed by treating a metal or its base with an acid, though practically all of them can be so produced. Many of the acids do not exist as such, and others, though formation is possible, are of such a weak or unstable nature that their use outside of a laboratory would be most impracticable, and in most instances formation of salts by such a method would prove too costly. In practice, therefore, compounds are produced usually by other methods, an outline of which will be given later.

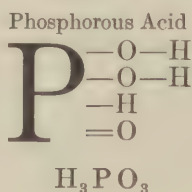
Most of the acid-forming elements are polyvalent, and therefore they can unite with oxygen to produce more than one oxide. In the cases of those elements which form only two oxides, as nitrogen or arsenic, the nomenclature is easy and is carried out exactly as described for all binary compounds; that is, there would be nitrous and nitric oxides and arsenic and arsenous oxides.

In examining chlorine it will be seen that this element possesses four distinct sets of valencies, and therefore can unite with oxygen in four ways. It develops that chlorine, as well as others of these polyvalent elements, has two sets of valencies with which it unites with oxygen much more often than it does with its other two sets. Also that these more common compounds with oxygen are much more stable. To the compounds formed by these two sets of valencies the endings *ic* and *ous* are given. Thus we get chloric oxide (Cl_2O_5) and chlorous oxide (Cl_2O_3), in which the valence of chlorine is V and III, respectively. For the oxides next above the *ic* form the prefix *per* is used, and for the oxide next below the *ous* form the prefix *hypo*. Accordingly the oxides of chlorine are named as follows: *Perchloric oxide*, *chloric oxide*, *chlorous oxide*, and *hypochlorous oxide*. Such oxides, as previously described, also may be named by the use of Greek numerals. Therefore, for example, chloric oxide correctly may be called chloric oxide, chlorine pentoxide, or chloric anhydride.

As has been said, an acid is produced by dissolving a negative oxide (acid anhydride) in water, and the acid so produced inherits the name of the oxide, the word "acid" simply being substituted for the word "oxide"; therefore sulphuric oxide produces sulphuric acid, nitric oxide produces nitric acid, and hypophosphorous oxide produces hypophosphorous acid, and chloric, iodic, and bromic acids are derived, respectively, from chloric, iodic, and bromic anhydrides. The negative element which unites with oxygen to form an acid anhydride is known as the "characteristic" element of that oxide and of the acid produced from it. *It is the element that gives the acid its name.* Thus sulphur is the characteristic element in sulphuric acid, etc. The reaction that actually occurs when an anhydride is dissolved in water is that the two molecules unite in such a manner that one or more hydroxyl groups are formed, so that, if lines are used to designate valence or bonds, the transformation that takes place is as shown in the following graphic formula of sulphuric acid:



It should be noted that it is only the hydrogen contained in the hydroxyl group of a ternary acid that can be replaced by a metal or a base. Usually in all inorganic acids all of the hydrogen is so combined but not always. The formula given for phosphorous acid in Table III is H_3PO_3 , but only two of the hydrogen atoms can be replaced for the reason that only two are contained in hydroxyl groups, as is shown below by the graphic formula of that acid, and experiments have proven that hydrogen not so contained is not replaceable by a positive element.



Phosphorous acid is the only one listed in Table III containing hydrogen that is not part of a hydroxyl group, and is therefore the only one so listed in which all the hydrogen can not be replaced.

Bases as a general rule are compounds of electropositive elements with oxygen or with oxygen and hydrogen. They frequently are spoken of as hydroxides and alkalies, and often are considered as electropositive elements or radicles which are united with hydroxyl (OH). Bases have several characteristic properties, such as:

- (a) Reaction with acids to form salts.
- (b) Alkaline reaction, if soluble, turning litmus from red to blue.
- (c) Soapy, alkaline taste, if soluble.
- (d) Power to interact with acids and neutralize them, taking away their characteristic properties.

In theory, for purposes of nomenclature, bases are regarded as being formed either by the direct union of some basic element and oxygen, as calcium oxide, CaO , or by the action of a positive element or its oxide on water, whereby a hydroxide is formed, as potassium hydroxide, KOH . A hydroxide is a compound in which an atom of an element is combined with one or more groups of hydroxyl ($-\text{OH}$). Being a radicle, hydroxyl can not exist by itself. When combined as a hydroxide it may be regarded as water in which one of the hydrogen atoms has been replaced by another element. Hydroxides are regarded as binary compounds, since the group ($-\text{OH}$) acts much the same as a univalent element. Hydroxides must not be confused with hydrates. The latter are additive compounds of one or more whole molecules of water with a molecule of some other compound, such as, for instance, terpin hydrate ($\text{C}_{10}\text{H}_{20}\text{O}_2 \cdot \text{H}_2\text{O}$).

When acids are mixed with bases mutual arrangements of the compositions of these substances take place, and the products of this interaction between acids and bases are known as salts. This term should not be confused with the common name of sodium chloride, "salt."

Salts are compounds formed when all or a part of the replaceable hydrogen in an acid has been replaced by a positive element. There are four kinds of salts, classified according to the amounts of the acids and bases entering into the reaction, and are known as normal or neutral, acid or mixed, double, and basic or oxy or sub.

Normal salts are those in which *all* the replaceable hydrogen of an acid has been replaced by a metal or base, as in calcium sulphate (CaSO_4).

Acid salts are those in which the amount of the base is not sufficient to allow complete reaction and only a part of the replaceable hydrogen of the acid can be replaced by a metal or base, as sodium acid sulphate (NaHSO_4). Because of the presence of this unreplaceable hydrogen, acid salts are named as above, and their formulas always contain an H. They also are designated as hydrogen salts or, instead of using the word acid or hydrogen in their names, the prefix "bi" may be used, and when so used always denotes an acid salt. Its use in any other kind of compound is incorrect, and therefore should never be used in place of the Greek numeral "di" to indicate a double quantity. Bichloride of mercury is an example of the incorrect use of this word. Sodium acid sulphate, then, correctly may be called by that name or sodium hydrogen sulphate or sodium bisulphate.

Double salts are those in which the hydrogen of an acid has been replaced by two or more elements, as in sodium and potassium sulphate, NaKSO_4 , or by an element and a radicle, as in sodium ammonium sulphate, NaNH_4SO_4 .

Basic salts are those which contain more base than is required to form a normal salt. Their structure is generally somewhat complicated. They are

regarded generally as being formed when there is not enough acid present to neutralize the base. An example of a basic salt is bismuth subnitrate or, as it is sometimes called, bismuth oxynitrate. This basic salt is prepared by the decomposition of bismuth nitrate in a large quantity of water according to the following reaction:



In the reaction shown above it might seem that there was sufficient nitric acid present to neutralize the base (a metal in this case) but immediately water is added to the normal salt (bismuth nitrate), two of the acid anhydrides (NO_3) in it combine with two of the hydrogen atoms in the water to form nitric acid, so it can be seen that there is not enough acid (NO_3) present in bismuth subnitrate to neutralize the base, the base bismuth having a valency of 3 while the valency of the acid anhydride is but 1.

Just as the acids are named from the anhydrides from which they are derived, so, too, are salts named from the acid which produces them, by naming the first or basic part of the salt just as described for the basic part of binary salts and dropping the ending of the names of the acid and substituting other endings. Since the salt of a binary acid is itself a binary compound its name must end in "ide" so that from a reaction of zinc and hydrochloric acid would be obtained zinc chloride. The names of all ternary acids, as has been learned, end either in "ous" or "ic" and the names of the salts from these acids end in "ite" or "ate" respectively. In all salts, except binaries, any prefix the acid may have had is carried over and incorporated in the name of the salt. Thus it may be said that "ous" acids produce "ite" salts, "ic" acids produce "ate" salts, "per-ic" acids produce "per-ate" salts, "hypo-ous" acids produce "hypo-ite" salts, and "meta-ic" acids produce "meta-ate" salts. Similarly, any other prefix the name of a specific acid may have is inherited by any salt it may produce, as, for instance, pyrophosphoric acid produces pyrophosphates.

All rules are tested by the exceptions thereto, and it must not be inferred from anything that has been said, or from anything which follows, that in all instances the facts will adhere rigidly to the theory laid down. The scheme of nomenclature for acids and salts herein described is conceived as the one most nearly fitting all cases. It is purely theoretical and conceives that all acids are formed from their respective anhydrides, as described above, and further, that all salts are derived directly through the action of an acid on a positive element, or upon an oxide or hydroxide of a positive element (bases).

For the reason that ternary acids are produced from binary compounds and all other ternary compounds in turn are derived from the acids, and in order to determine the formula of any salt, it is necessary that the formula of every acid listed in Table III be committed to memory. Just as it is important to know the valencies of the different elements before it is possible to accurately write the correct formula for any acids, so it is important to know these formulas before it will be possible to write the formula of any compound (salt) derived from them.

GENERAL CONSIDERATION OF THE ELEMENTS.

Having considered many of the general principles of chemistry and something of the relation between the sciences of physics and chemistry, it is but fitting that elements themselves should be discussed.

The definition and number of elements and many of their qualities have been given and will not be repeated now. As has been explained before, there are but comparatively few of the total number of known elements that are of any great importance. The greater part of the solid portion of the earth, of animal and vegetable matter, and water and the air are composed of these few elements—about 20 in number. To show how important are these few elements the following examples are given:

(a) It has been estimated that approximately 8 elements make up the crust of the earth, and of these oxygen forms nearly 48 per cent.

(b) About eight-ninths of the water (by weight) is oxygen.

(c) By volume air consists of almost one-fifth oxygen and four-fifths nitrogen.

(d) The principal element entering into the structure of living things is carbon.

(e) Hydrogen, oxygen, and nitrogen are essential constituents of animal and vegetable life.

To simplify the study of the elements, it has been found desirable and convenient to group them into classes or families according to the similarity of their general chemical properties. In this way knowledge of one element affords an indication of the characteristics of the others in the same class, as often the members of the same family show striking resemblances to one another. Some of these families, with the family name and members, are as follows:

Family.	Chlorine.	Sulphur.	Calcium.
Members.....	Chlorine..... Bromine..... Iodine..... Fluorine.....	Sulphur..... Selenium..... Tellurium.....	Calcium. Strontium. Barium.

In addition to this arrangement in family groups another natural classification of the elements divides them into metals and nonmetals, or metalloids, as the latter are sometimes called.

Such elements as possess what is known as metallic luster, are good conductors of electricity and heat, form bases when combined with oxygen, and are capable of replacing all or part of the hydrogen in acids, are classed as *metals*.

Elements which do not have the above properties and whose physical and chemical properties are entirely different from those of the metals are classed as *nonmetals*, although the oxides of these elements when in combination with water may have acid properties, and in this one respect somewhat resemble the metals.

In the discussion of physical properties of matter it was explained that it exists in three forms—solid, liquid, and gaseous. Elements, being elementary matter, also have physical properties, and in the consideration of these physical properties it is found that there are solid, liquid, and gaseous elements. At ordinary temperature the majority of elements are solid substances, two are liquid (bromine and mercury), and many are gases. Five of the elements found in the latter form, and among the most important, are hydrogen, oxygen, nitrogen, chlorine, and fluorine.

Most, if not all, of the solid elements are found in various forms having names descriptive of these peculiarly characteristic arrangements. Thus there are solids in the crystalline form, the shape of the *crystals* showing perfect

geometrical figures and differing in each substance which is crystallizable; solids known as *isomorphous* having the same general formation, as all the alums; solids termed *amorphous* having no definite or distinctive formation, such as red iodide of mercury; and solids called *dimorphous* or *polymorphous* which appear respectively in two or more different forms, as carbon, sulphur, etc. The assumption of such different forms by elements is called *allotropy* and the different forms are spoken of as *allotropic modifications*.

A few of the gaseous elements also are capable of existing in more than one form, as oxygen, an allotropic modification of which is ozone.

A few of the elements have a distinctive odor or taste, as chlorine, iodine, and bromine, but most do not.

In studying the nonmetals the facts concerning them generally considered are:

- (a) Symbols, atomic weights, and derivation of names.
- (b) State of aggregation, as solid, liquid, or gaseous, and valencies.
- (c) Occurrence in nature, as in a free or combined state or in combination only.
- (d) Time of discovery and history; sources.
- (e) Preparation and properties.

For the metals the facts generally considered are:

- (a) Symbols, atomic weights, and derivation of names.
- (b) Melting points, specific gravities, and valencies.
- (c) Occurrence in nature, as in a free or combined state or in combination only.
- (d) Time of discovery and history; sources.
- (e) Classification, as light metals (earth metals, alkaline earth metals, and alkali metals) and heavy metals (arsenic group, lead group, and iron group).
- (f) Properties, manufacture and alloys.

Most of the elements known as metals have a white, grayish, bluish white, or dark gray color, but a few other colors are known, as red (copper) or yellow (gold).

All metals are fusible, and some are so volatile that they can be distilled. Some metals (as iron) will lose their metallic luster when exposed to the air and even burn if heated to a high enough degree, while others retain it.

Metals whose oxides are decomposed into oxygen and the respective metal by the application of heat alone are termed *noble metals* (gold, silver, mercury, and platinum are examples), the others *base metals*.

Among the classification of metals given above appear alkalies and alkaline earths. An *alkali* is described chemically as any substance having marked basic properties, and characterized by the taste peculiar to them and their power to form salts with acids and turn red litmus paper to blue. They all are of soft wax-like consistence, oxidize in the air, and energetically decompose water. The stronger alkalies are caustic and react with fats and oils to form soaps and of all the metals are the only ones whose hydroxides and carbonates are not decomposed by heat. An *earth*, in chemistry, is a metallic oxide difficult to reduce, and these substances once were classed as elements. *Alkaline earths* are substances named as such because their properties are intermediate between alkalies and earths, while resembling both, and usually are the oxides of barium, calcium, and strontium. They have a distinct luster and are white or yellow in color; and though they decompose water, it is done much more

slowly than by the alkalis. A characteristic of the alkaline earths to be remembered is the insolubility of their carbonates, sulphates, and phosphates.

The addition of oxygen to an element to form a different substance is *oxidation*, and the removal of oxygen from a compound is *reduction*. Substances which introduce oxygen into an element are known as *oxidizing agents*, and examples are nitric acid and potassium permanganate, these substances as well as others freely giving up their oxygen to combine with other elements.

An example of a *reducing agent*, a substance capable of abstracting oxygen from a compound, is hydrogen, which, as is well known, easily combines with oxygen to form water.

LAWS AND THEORIES.

In studying the various elements which unite with each other to form more than one compound it has been found that "*if two elements, A and B, are capable of uniting in several proportions, the quantities of B which combine with a fixed quantity of A bear a simple ratio to each other.*" This is known as the law of multiple proportions, or Dalton's law, and, stated more simply, means that if two elements, "A" and "B," can unite with each other to form two or more compounds, as "AB" and "AB₂," the weights of "B" in "AB" and in "AB₂" bear a simple relationship to each other.

The general principles of both the atomic and the molecular theories have been explained, but it is well to state here that a theory differs from a law. While a law is a general summing up of facts actually proven, a theory is only a presumption that certain things are true, based probably upon strong circumstantial evidence, but upon no actual, concrete, proven facts. It has never been possible to divide a portion of a compound so minutely as to be able to isolate or see a single molecule nor, obviously, to reduce a single molecule to its component atoms. Yet chemists believe that some such particles do exist, and that they behave as has been explained before. A Portuguese chemist, Avogadro, is considered as the father of the molecular theory, for, while engaged in studying atomic and combining weights, he advanced the theory of double atoms, or molecules, as an explanation for the action of certain gases that could not be accounted for solely by the atomic theory. In this connection Avogadro enunciated the hypothesis, or law as it usually is known, which bears his name: "*Equal volumes of gases under the same conditions always contain the same number of molecules,*" and he explained that a molecule was a combination of two or more atoms. If this hypothesis be correct, and it is so regarded, then at any given temperature and pressure a liter of any pure gas will contain exactly the same number of molecules as a liter of any other pure gas contains under the same conditions; no more, no less. It has been determined by careful experiments that 2.016 grams of hydrogen (its molecular weight expressed as grams) will have a volume of 22.38 liters if measured under standard conditions; that is, at a temperature of 0° C. and a barometric pressure of 760 mm. If equal volumes of gases contain equal numbers of molecules under the same conditions, and if there is a definite relationship between the weights of all atoms and molecules, it follows then that there must be a definite relationship between the molecular volumes of all gases. Briefly stated, and for the reasons set forth above, it is known that *the molecular weight of any pure gas, when expressed in grams,*

will, under standard conditions, have a volume of 22.38 liters. An illustration may help—thus:

Gas.	Formula.	Molecular weight.	Molecular volume.
Chlorine.....	Cl ₂	71	L. 22.38
Hydrochloric acid.....	HCl.....	36.5	22.38
Carbon dioxide.....	CO ₂	44	22.38
Nitric oxide.....	N ₂ O.....	94	22.38

This factor of molecular volume is useful in calculating the volume of any gas that may be formed in a given reaction. Thus, referring to a problem previously stated wherein the weight of sulphuric acid was sought, consider that the volume of HCl also was required. The molecular weight of HCl is 36.5 and the volume sought is that of 1.125 grams of that acid. Therefore:

$$36.5 : 1.125 :: 22.38 : x$$

in which x will equal 689.7+liters. It rarely occurs, however, that standard conditions obtain either when the reaction takes place or when the gas is measured, so that the volume of the gas must be adjusted to the conditions that actually exist at the time. *Boyle's law* states that *the volume of a gas varies inversely as the pressure and directly as the temperature*. If a cork is pressed it shrinks in size, and the same thing is true of gases, whether the pressure be mechanical or due to atmospheric conditions, and furthermore its shrinkage is in direct ratio to the increase of pressure; thus 100 c. c. of a gas at a pressure of one atmosphere (760 mm.) would shrink to 50 c. c. when subjected to a pressure of two atmospheres (1,520 mm.), thus:

$$760 : 1520 :: 100 : 50.$$

It is apparent that the volume decreases as the pressure increases.

For corrections due to changes in temperature *Charles' law* states that *a gas not only increases or decreases in volume, according as the temperature is increased or decreased, but it does so in a regular progression, which is the same in all cases*. This expansion or shrinkage amounts to 1/273 of the volume of gas at 0° C. (1/493 for each degree F.). If 1 c. c. of gas, measured at 0° C., was cooled through all the successive degrees below 0° C. it would, according to this law, completely disappear, at -273° C. The latter is, therefore, designated as absolute zero. Absolute zero has never been reached, but in experiments with helium it has been closely approached. Volumes of gases may be adjusted for temperature also through the use of a statement in proportion. Thus, assume that the 100 c. c. of gas, alluded to above, were measured at 0° C. and again at 15° C.; then:

$$273 : 273 + 15 :: 100 : x$$

in which x will equal 109.15, the volume of gas at 15° C.

Of interest, but not of great importance at this point, are the law of Gay Lussac and the law of Henry. *Gay Lussac's law* states that *when two or more*

gaseous constituents combine chemically and the product so produced is also a gas, the combined volumes of the original gases bear a simple relation to the volume of the product. Henry's law has to do with solution of gases and states that the quantity of a gas dissolved by a given quantity of a liquid is proportional to the pressure of the gas.

Another law, relative to the effects of light, heat, etc., as well as other factors, in reactions, is known as the law of chemical and physical equilibrium. *When chemical or physical equilibrium exists, and one of the factors upon which it depends is altered, a change is produced which opposes the first equilibrium.* Thus, hydrogen and chlorine may be mixed at a low temperature in the dark and no change or reaction will take place, but if the temperature is raised or sunlight admitted the two will unite with explosive violence.

ACIDIMETRY AND ALKALIMETRY.

For the benefit more especially of those having some knowledge of chemistry and whose work may require the use of test solutions and indicators and a knowledge of the methods used in calculating the results obtained the following brief discussion of these advanced chemical procedures is given.

An alkali is an oxide or hydroxide of an alkali metal. The alkali metals are lithium, sodium, potassium, rubidium, and caesium. These alkalies and certain other oxides and hydroxides of the alkaline earths, particularly those of calcium, and also ammonium hydroxide, are used in acidimetry and alkalimetry. It has been learned that the compounds named above neutralize acid to form salts and definite weights of each are involved. Therefore by the use of a solution of known strength of either an acid or an alkali, and being provided with the means of determining just when absolute neutralization is effected it follows that the strength of either may be readily ascertained. The means of determining the point of neutralization generally is by the use of a solution known as an *indicator*. Indicators lose or change color in the presence of certain acids or alkalies, and by noting such loss or change the exact point of neutralization easily is determined.

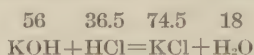
Ordinarily the testing solution is placed in a long, cylindrical, graduated glass container known as a burette, which is provided with a stopcock and small orifice so that the liquid may be let out by drops. A sample of the liquid to be tested is placed in a glass beaker directly beneath the burette and a few drops of the proper indicator added thereto. The testing solution then is allowed to drop into the latter liquid drop by drop until the color of the indicator is lost or changed, depending upon the nature of the specific solution used. This operation is known as *titration*. When neutralization has been effected, a reading is made from the burette and the amount of testing solution used is noted. The reacting weights of the compounds involved are calculated, and then by proportion, as explained before, the amount of active substance in the volume of the solution actually tested is ascertained, from which it is simple to calculate either the percentage strength or the actual amount of substance contained in any volume of the solution.

The testing solutions generally used for the purposes described above are known as *volumetric solutions*, and they are prepared in such a manner as to

contain in 1 liter a definite weight of replaceable hydrogen or its equivalent. A *normal volumetric solution* ($\frac{N}{1}$ VS) contains 1 gram of replaceable hydrogen or its equivalent to a liter. A *tenth-normal volumetric solution* ($\frac{N}{10}$ VS) is 1/10 the strength of a normal volumetric solution—that is, it contains 1/10 of a gram of replaceable hydrogen or its equivalent to a liter. A *hundredth-normal volumetric solution* ($\frac{N}{100}$ VS) is 1/100 the strength of a normal volumetric solution, and a *double-normal volumetric solution* ($\frac{2N}{1}$ VS) is twice the strength of a normal volumetric solution, etc.

To prepare a normal volumetric solution of an acid, as 1 gram of replaceable hydrogen is required for each liter of finished solution, it follows that in the case of unibasic acids, such as hydrochloric acid, by taking the molecular weight of the acid expressed in grams and dissolving in enough water to make a liter (1,000 c. c.), the required amount of hydrogen will be secured. Sulphuric acid is a dibasic acid and its molecular weight is 98. As it contains two hydrogen atoms to a molecule, there are 2 grams of replaceable hydrogen in every 98 grams of acid; therefore one-half of its molecular weight, expressed in grams, would be used, as is also true of all other dibasic acids. For tribasic acids one-third of the molecular weight, expressed in grams, would be used. To make a volumetric solution other than a normal one the amount required for a normal solution first is ascertained and then adjusted for the strength desired. It is obvious that specific gravity, purity, etc., are factors that must be taken into consideration in preparing the solution.

Calculation following titration.—A solution of 1,000 c. c. of KOH is to be tested to determine the amount of KOH contained in it by titration with $\frac{N}{10}$ VS of HCl. One thousand c. c. of such a VS would contain 3.65 grams of HCl, and 10 c. c., the amount that would be used, would contain 0.0365 gram. To this 10 c. c., contained in a beaker, a few drops of a 1 per cent alcoholic solution of phenolphthalein is added and the solution placed below the burette containing the KOH solution, which then is allowed to drop into the solution of HCl. When, for example, 2 c. c. of the KOH solution has run into the acid, the color of the latter suddenly develops a faint pinkish tint that does not disappear when the beaker is shaken, indicating that the acid is neutralized. The titration then is stopped. HCl and KOH react as follows:



Since 36.5 grams of HCl will neutralize 56 grams of KOH, then:

$$\begin{array}{l} 36.5 : 56 :: .0365 : x \\ x = .056 \end{array}$$

Since 2 c. c. of the KOH solution tested contained 0.056 gram of KOH, 1,000 c. c. would contain 28 grams of KOH. This problem might be reversed and the amount of absolute HCl in a given volume determined by titrating against a VS of KOH.

REFERENCES.

- Manual of Chemistry.—Simon.
Pharmaceutical and Medical Chemistry.—Sadtler and Coblenz.
Compend of Medical Chemistry.—Leffmann.
Introduction to the Study of Chemistry.—Remsen.
Outlines of Chemistry.—Kahlenberg.

TABLE I.

TABLE OF ELEMENTS AND THEIR ATOMIC WEIGHTS.

[Adopted by the International Committee on Atomic Weights in 1915. (O=16.) Latin names in parentheses.]

Name.	Symbol.	Atomic weight.	Name.	Symbol.	Atomic weight.
Aluminium.....	Al.....	27.1	Molybdenum.....	Mo.....	96.0
Antimony (<i>Stibium</i>).....	Sb.....	120.2	Neodymium.....	Nd.....	144.3
Argon.....	A.....	39.88	Neon.....	Ne.....	20.2
Arsenic.....	As.....	74.96	Nickel.....	Ni.....	58.68
Barium.....	Ba.....	137.37	Niton (Radium emanation).....	Nt.....	222.4
Bismuth.....	Bi.....	208.0	Nitrogen.....	N.....	14.01
Boron.....	B.....	11.0	Osmium.....	Os.....	190.9
Bromine.....	Br.....	79.92	Oxygen.....	O.....	16.0
Cadmium.....	Cd.....	112.4	Palladium.....	Pd.....	106.7
Cæsium.....	Cs.....	132.81	Phosphorus.....	P.....	31.04
Calcium.....	Ca.....	40.07	Platinum.....	Pt.....	195.2
Carbon.....	C.....	12.0	Potassium (<i>Kalium</i>).....	K.....	39.1
Cerium.....	Ce.....	140.25	†Praseodymium.....	Pr.....	140.6
Chlorine.....	Cl.....	35.46	Radium.....	Ra.....	226.4
Chromium.....	Cr.....	52.0	Rhodium.....	Rh.....	102.9
Cobalt.....	Co.....	58.97	Rubidium.....	Rb.....	85.45
*Columbium.....	Cb.....	93.5	Ruthenium.....	Ru.....	101.7
Copper (<i>Cuprum</i>).....	Cu.....	63.57	Samarium.....	Sa.....	150.4
Dysprosium.....	Dy.....	162.5	Scandium.....	Sc.....	44.1
Erbium.....	Er.....	167.7	Selenium.....	Se.....	79.2
Eurepium.....	Eu.....	152.0	Silicon.....	Si.....	28.3
Fluorine.....	F.....	19.0	Silver (<i>Argentum</i>).....	Ag.....	107.88
Gadolinium.....	Gd.....	157.3	Sodium (<i>Natrium</i>).....	Na.....	23.0
Gallium.....	Ga.....	69.9	Strontium.....	Sr.....	87.63
Germanium.....	Ge.....	72.5	Sulphur.....	S.....	32.07
†Glycerium.....	Gl.....	9.1	Tantalum.....	Ta.....	181.5
Gold (<i>Aurum</i>).....	Au.....	197.2	Tellurium.....	Te.....	127.5
Helium.....	He.....	3.99	Terbium.....	Tb.....	159.2
Holmium.....	Ho.....	163.5	Thallium.....	Tl.....	204.0
Hydrogen.....	H.....	1.008	Thorium.....	Th.....	232.4
Indium.....	In.....	114.8	Thulium.....	Tm.....	168.5
Iodine.....	I.....	126.92	Tin (<i>Stannum</i>).....	Sn.....	119.0
Iridium.....	Ir.....	193.1	Titanium.....	Ti.....	48.1
Iron (<i>Ferrum</i>).....	Fe.....	55.84	Tungsten (<i>Wolfram</i>).....	W.....	184.0
Krypton.....	Kr.....	82.92	Uranium.....	U.....	238.5
Lanthanum.....	La.....	139.0	Vanadium.....	V.....	51.0
Lead (<i>Plumbum</i>).....	Pb.....	207.1	Xenon.....	Xe.....	130.2
Lithium.....	Li.....	6.94	Ytterbium (Neoytterbium).....	Yb.....	172.0
Lutecium.....	Lu.....	174.0	Yttrium.....	Yt.....	89.0
Magnesium.....	Mg.....	24.32	Zinc.....	Zn.....	65.37
Manganese.....	Mn.....	54.93	Zirconium.....	Zr.....	90.6
Mercury (<i>Hydrargyrum</i>).....	Hg.....	200.6			

* Also called Niobium, Nb. † Also called Beryllium, Be. ‡ Also called Didymium, Di.

TABLE II.

POSITIVE ELEMENTS.

Base formers.

Valence I.	Valence II.	Valence III.	Valence I and II.	Valence II and III.	Valence III and IV.
Ag	Ba	Al†	Cu	Fe	Pt
K	Ca	Bi	Hg		Sn
Li	Mg				
Na	Ni				
	Pb				
	Zn†				

† Aluminium and zinc, in a few cases, act as negatives, occurring in compounds as the "characteristic" element in the radicle, forming aluminates and zincates.

NEGATIVE ELEMENTS.

Acid formers.

Valence I.	Valence II.	Valence III and V.	Valence IV.	Valence I, III, V, and VII.	Valence II, IV, and VI.
F H*	O	As† N P Sb‡	C Si	Br Cl I	Mn† S§

GROUPS OR RADICLES.

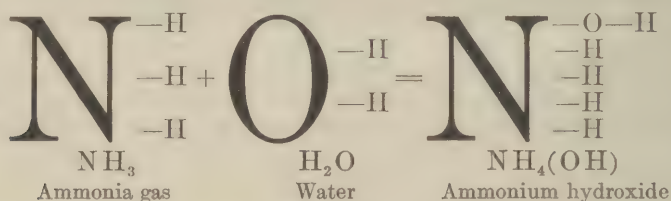
POSITIVE; Valence I.	NEGATIVE; Valence I.
Ammonium, NH_4^+	Hydroxyl, $-\text{OH}$ <i>Forms hydroxides.</i> Cyanogen, $-\text{CN}$ <i>Forms cyanides.</i>

* Hydrogen is a positive element but is classed here with the negative group for the reason that it is the one element that is present in all acids and because it is not a base-forming element.

† Manganese, arsenic, and antimony act as weak bases under some conditions.

§ In some compounds sulphur seems to have a valence of VIII.

Ammonium.—The positive radicle ammonium, $-\text{NH}_4$, can not exist by itself. When ammonia gas, NH_3 , is dissolved in water a molecule of each unite to form ammonium hydroxide, NH_4OH . Chemically, ammonia is nitrogen trihydride, and as such the nitrogen must have a valence of III. When brought in contact with water the nitrogen is considered to be oxidized to its maximum valence, V, with which it can hold the four hydrogen atoms and one hydroxyl group. This hydroxyl group can be exchanged for other radicles similarly, as though it were attached to a single positive element. The formation of ammonium hydroxide is shown graphically:



Hydroxyl.—The univalent radicle OH, consisting of one atom of hydrogen and oxygen. It can not exist by itself, and is a characteristic part of bases, alcohols, oxyacids, etc.

Cyanogen.—Cyanogen is an organic compound whose formula is C_2N_2 . It can combine with a molecule of hydrogen to form HCN, thus $\text{H}_2 + \text{C}_2\text{N}_2 = \text{H}_2\text{C}_2\text{N}_2$ or 2HCN . The group $-\text{CN}$ resembles a monovalent element in its actions, and salts containing the group therefore are classed as binaries.

TABLE III.

INORGANIC ACIDS.

Binary or hydracids.

Name.	Formula.	Name.	Formula.	Name.	Formula.
Hydrobromic.....	HBr	Hydrocyanic.....	HCN	Hydriodic.....	HI
Hydrochloric.....	HCl	Hydrofluoric.....	HF	Hydrosulphuric.....	H ₂ S

These acids form salts whose names terminate in the ending *ide* and the prefix *hydro* is not used in naming the salt. Thus hydrochloric acid produces chlorides and hydrosulphuric acid produces sulphides.

Ternary or oxyacids.

Name.	Formula.	Name.	Formula.	Name.	Formula.
Bromic.....	HBrO ₃	Perchloric.....	HClO ₄	Pyrosulphuric.....	H ₂ S ₂ O ₇
Bromous.....	HBrO ₂	Chloric.....	HClO ₃	Sulphuric.....	H ₂ SO ₄
Hypobromous.....	HBrO	Chlorous.....	HClO ₂	Thiosulphuric.....	H ₂ S ₂ O ₃
Arsenic.....	H ₃ AsO ₄	Hypochlorous.....	HClO	Sulphurous.....	H ₂ SO ₃
Arsenous.....	H ₃ AsO ₃	Iodic.....	HI O ₃	Hyposulphurous.....	H ₂ SO ₂
Perboric (Tetra).....	H ₂ B ₃ O ₇	Nitric.....	HNO ₃	Pyrophosphoric.....	H ₄ P ₂ O ₇
Boric.....	H ₂ BO ₃	Nitrous.....	HNO ₂	Phosphoric.....	H ₃ PO ₄
Metaboric.....	HBO ₂	Silicic.....	H ₄ SiO ₄	Metaphosphoric.....	HPO ₃
Permanganic (di).....	H ₂ Mn ₂ O ₈	Metasilicic.....	H ₂ SiO ₃	Phosphorous.....	H ₃ PO ₃
Manganic.....	H ₂ MnO ₄	Chromic.....	H ₂ CrO ₄	Hypophosphorous.....	H ₃ PO ₂
Carbonic.....	H ₂ CO ₂	Persulphuric.....	H ₂ S ₂ O ₈	Cyanic.....	HCNO

Salts formed by these acids are named as follows: Acids whose names end in *ic* produce salts whose names end in *ate*; acids whose names end in *ous* produce salts whose names end in *ite* and any prefix occurring in the name of the acid before the part referring to the "characteristic" element also is used in the name of the salt. Thus sulphuric acid produces sulphates, sulphurous acid produces sulphites, and persulphuric acid produces persulphates.

Some of these acids may not actually exist and some are so unstable that their actual use, outside a laboratory, would be impracticable, but salts of all of them are existent.

The formulas shown above are molecular formulas in that they express the content, qualitatively and quantitatively, of a molecule.

CHAPTER VII.

PHARMACY.¹

Pharmacy is the science which treats of medicinal substances and includes, in addition to the art of preparing and dispensing them, their identification, selection, preservation, combination, and analysis. It is also the name of a place where medicines are sold, a drug store. Pharmacy is divided into two great classes—theoretical and practical.

Theoretical pharmacy embraces those sciences which treat of the substances used as medicines that are obtained from the vegetable, mineral, and animal kingdoms, as well as the laws governing them. In the study of pharmacy a knowledge of several other sciences is necessary and these are:

Botany, the science or study of plants.

Mineralogy, the science of inorganic substances found in and on the earth.

Zoology, the science which treats of animals.

Physics, the science which describes and explains the changes produced in bodies by which their original identity is not destroyed.

Chemistry, the science which treats of those changes which alter the original identity of bodies.

Materia medica, the science which treats of the medicinal substances that are used in the treatment of diseases.

Posology, the science of dosage.

Pharmacognosy, the science which treats of crude drugs.

Toxicology, the science which treats of poisons.

Bacteriology, the science which treats of microörganisms.

Practical pharmacy is that branch of pharmacy which treats of the operations, processes, and methods used in applying the principles of theoretical pharmacy.

PHARMACOPŒIAS, DISPENSATORIES, AND THE NATIONAL FORMULARY.

A *pharmacopœia* is an authoritative list of medicinal substances, with definitions and descriptions or formulas for their preparation. All civilized nations recognize the necessity for authoritative standards defining the character, establishing the purity, and regulating the strength of medicines. Some countries have no pharmacopœia of their own and usually adopt those of other countries or supply standard pharmaceutical works for the same purpose. The General Government and those of the several States accept the United States Pharmacopœia, which is issued under the authority of the Government, as authoritative. It is revised every 10 years by a committee appointed from the professions of medicine and pharmacy.

The titles of the medicinal substances are indicated in the United States Pharmacopœia by—

- (1) The official Latin title. Example: *Ceratum. resinæ.*
- (2) The official English title. Example: *Rosin cerate.*
- (3) The synonym. Example: *Basilicon ointment.*

¹ Prepared by Chief Pharmacist L. W. Rider, United States Navy.

(4) The botanical name (in the case of plants). Example: *Acacia senegal*.

(5) The symbolic formula (in the case of chemicals). Example: $KClO_3$.

The official Latin title is used in designating the drug when precision is required. Because it is a dead language and not liable to change, the Latin language was chosen. The official English title is employed in ordinary conversation and commercial transactions. Synonyms are usually from old and unscientific sources, but long usage prevents their being entirely ignored. The botanical name is that which is recognized by botanists for plants and serves as the base of the official name. An example is *Capsicum fastigiatum*, the botanical name for cayenne pepper, *capsicum* indicating the genus and *fastigiatum* the species to which the plant belongs. To establish the identity of vegetable drugs, it is absolutely necessary to use the botanical name.

A symbolic formula is a combination of chemical symbols representing briefly and exactly the structure of the article to which they refer. Examples: HCl ; H_2SO_4 ; HNO_3 .

A rule known as the *purity rubric* was introduced into the United States Pharmacopœia to limit the quantity of harmless impurities in chemicals and of foreign matter in vegetable drugs. It might seem that chemicals should be always 100 per cent pure, but practical experience has shown that absolute purity can not be had without greatly increasing the cost of the article, and the presence of very small quantities of *harmless* impurities does not affect their medicinal value. Foreign matter in vegetable drugs usually refers to foreign substances whose presence or admixture is excluded, but in some cases refers to the roots, stems, or seeds of the same plant from which the drug is obtained.

The doses used in the United States Pharmacopœia give the average approximate dose for adults in the metric system and the equivalent in ordinary weights and measures. It should be remembered that it is only the average dose which is given.

Dispensatories furnish comments on the drugs and chemical substances described in the United States Pharmacopœia and give their physical, medical, and pharmaceutical histories as well as their doses and uses. In them is presented information concerning important nonofficial drugs and official drugs in other pharmacopœias. Two of the principal dispensatories are the United States Dispensatory and the National Dispensatory.

The *National Formulary* is prepared by a committee appointed by the American Pharmaceutical Association, and is a legal standard, as the Pure Food and Drugs Act directs that the standard for drugs and preparations therein shall be employed in enforcing the several statutes. It contains reliable recipes for well-known pharmaceuticals, and also provides a standard for all drugs used in making preparations when such ingredients are not recognized by the United States Pharmacopœia.

METROLOGY.

Metrology is the study of measures of extension, volume, weight, and the relation of these to each other. The word is derived from Greek words meaning measure and discourse.

Weight is defined as the difference between the attraction of the earth and that of surrounding bodies for bodies on the surface of the earth. The weight of a body depends upon its bulk and density, density being the amount of matter in a given bulk of the body.

Weighing is the balancing of a body of known gravitating force with one whose gravity is not known to estimate the gravitating force of the latter, which is called its weight.

Weights are bodies of known gravitating force used for weighing. The apparatus used for weighing are scales and weights. Weights are based upon standards known as the grain and the meter.

The grain weight was established by an act of Henry III of England in 1206, who decreed that "An English silver penny, called the sterling, round and without clipping, shall weigh 32 grains of wheat, well dried and gathered out of the middle of the ear."

The metric system, often called the French or decimal system, originated with Prince de Talleyrand, Bishop of Autun, France, in 1790, and is now used legally by most of the civilized nations of the world. Even in countries where its use is not compulsory, as the United States, it finds especial favor with scientists in their technical work.

The basis of this system is the unit of length, the meter, which is about one forty-millionth part of the circumference of the earth around its poles and is equivalent to 39.37 inches. From the meter the units of capacity and weight are derived, the former being the liter which is the cube of one-tenth part of a meter, and the latter the gram which is the weight of that quantity of distilled water at 4° C.² which will fill the cube of one one-hundredth part of a meter. The denominations of this system are multiplied by the Greek words: *Deka*, meaning ten; *hecto*, meaning hundred; and *kilo*, meaning thousand, and are divided by the Latin words: *Deci*, meaning one-tenth; *centi*, meaning one-hundredth; and *milli*, meaning one-thousandth.

The weights and measures in general use in this country are *avoirdupois*, used in commercial buying and selling; *troy*, used by jewelers; *apothecaries*, used by pharmacists in compounding; and the *metric* system.

TABLES OF WEIGHTS AND MEASURES.

ENGLISH SYSTEM.	METRIC EQUIVALENT.
Avoirdupois weight:	
1 grain.....	gram.. 0.065
437.5 grains make 1 ounce (oz.).....	grams.. 28.35
16 ounces make 1 pound (lb.).....	do.... 453.60
100 pounds make 1 hundredweight (cwt.).	
20 hundredweight make 1 ton.	
Apothecaries' weight:	
1 grain.....	gram.. 0.065
20 grains make 1 scruple (℞).....	grams.. 1.30
3 scruples make 1 dram (ʒ).....	do.... 3.90
8 drams make 1 ounce (℥).....	do.... 31.103
12 ounces make 1 pound.....	do.... 373.236
Troy weight:	
1 grain.....	gram.. 0.065
24 grains make 1 pennyweight (dwt.).....	grams.. 1.555
20 pennyweights make 1 ounce.....	do.... 31.103
12 ounces make 1 pound.....	do.... 373.236
Apothecaries measure:	
1 minim (0.95 grain) (℥).....	c. c.. 0.06
60 minims make 1 fluid dram (ʒ).....	do.... 3.70
8 fluid drams make 1 fluid ounce (℥).....	do.... 29.57
16 fluid ounces make 1 pint (O).....	do.... 475.18
8 pints make 1 gallon ³ (Cong.).....	do.... 3,785.40
Linear measure:	
1 inch.....	millimeters.. 25.4
12 inches make 1 foot.....	centimeters.. 30.48
3 feet make 1 yard.....	meter.. 0.914
5.5 yards make 1 rod (or perch).	
40 rods make 1 furlong.	
8 furlongs make 1 mile.....	do.... 1,609.35

² This degree is specified as the temperature at which 1 c. c. of distilled water shall weigh 1 gram because at that temperature water has its maximum density; a given volume of water being lighter either above or below that temperature.

³ 1 gallon contains 231 cubic inches, and 1 fluid ounce of distilled water weighs 454.6 grains at 25° C.

METRIC SYSTEM.		ENGLISH EQUIVALENT.	
Length:			
Kilometer, 1,000 meters.....	.....	mile..	$\frac{1}{2}$
Hectometer, 100 meters.....	.....	
Decameter, 10 meters.....	.....	
Meter (unit).....	.....	inches..	39.37
Decimeter, one-tenth meter.....	.....	do.....	3.937
Centimeter, one-hundredth meter.....	.....	do.....	$\frac{1}{2}$
Millimeter, one-thousandth meter.....	.....	do.....	$\frac{1}{10}$
Capacity:			
Kiloliter, 1,000 liters.....	.....	
Hectoliter, 100 liters.....	.....	
Decaliter, 10 liters.....	.....	
Liter (unit), cube of one-tenth meter.....	.....	fluid ounces..	33.814
Deciliter, one-tenth liter.....	.....	do.....	3.3814
Centiliter, one-hundredth liter.....	.....	fluid ounces..	$\frac{1}{2}$
Milliliter, one-thousandth liter (c. c.).....	.....	minims.....	16.23
Weight:			
Kilogram, 1,000 grams.....	.....	apothecaries ounces..	32.15
Hectogram, 100 grams.....	.....	avoirdupois ounces..	35.27
Decagram, 10 grams.....	.....	
Gram (unit).....	.....	grains..	15.432
Decigram, one-tenth gram.....	.....	do.....	1.5
Centigram, one-hundredth gram.....	.....	do.....	$\frac{1}{2}$
Milligram, one-thousandth gram.....	.....	do.....	$\frac{1}{10}$
Approximate measures:			
		Apothecaries.	Metric.
A tumblerful.....	.....	$\frac{1}{2}$ viii.....	240 c. c.
A teacupful.....	.....	$\frac{1}{2}$ iv.....	120 c. c.
A wineglassful.....	.....	$\frac{1}{2}$ ii.....	60 c. c.
A tablespoonful.....	.....	$\frac{1}{2}$ iv.....	16 c. c.
A dessertspoonful.....	.....	$\frac{1}{2}$ ii.....	8 c. c.
A teaspoonful.....	.....	$\frac{1}{2}$ i.....	4 c. c.

To convert metric weights or measures into those in ordinary use multiply the metric quantities by the corresponding equivalent. Therefore, to convert:

Meters into inches, multiply by 39.370.

Liters into fluid ounces, multiply by 33.815.

Grams into grains, multiply by 15.432.

To convert the weights or measures in ordinary use into metric weights or measures multiply the quantities by the corresponding equivalent. Therefore, to convert:

Inches into meters, multiply by 0.0254.

Fluid ounces into milliliters, multiply by 29.572.

Grains into grams, multiply by 0.0648.

Balances and measures.

Balances are instruments for determining the relative weight of substances. There are five kinds:

- (1) Single beam, equal arm.
- (2) Single beam, unequal arm.
- (3) Double beam, unequal arm.
- (4) Compound lever balance.
- (5) Torsion balance.

In the construction of the single beam, equal arm, a beam is suspended on a knife-edge, which divides it into equal arms, and knife-edges are placed at each end of the beam on the same plane and at exactly equal distances from the point of suspension to support the pans which carry the substances to be weighed. The construction of the single beam, unequal arm, can be seen by inspecting the well-known Fairbanks scales. This type of balance depends on the principle in physics: "The power is to the weight or resistance in the inverse ratio of the arms of the lever." The longer arm of the beam is grad-

uated for a movable weight, the use of which dispenses with small weights and is a decided advantage.

In the double beam, unequal arm, the construction is the same as above, but with two parallel beams, and is employed for weighing liquids, etc., the outside beam being used to tare the bottle or jar.

A compound lever balance is well shown in Fairbanks platform scales. It is used on druggists' counters and sometimes for prescription scales.

A torsion balance is one in which a compound beam is balanced and supported upon an immovable frame. The beam is prevented from slipping out of place, and the torsion is secured by a flattened gold wire stretched with powerful tension upon the center frame and firmly fastened to the underside of the beam. Upon the ends of the beam are fastened the movable frames which support the pans. Motion of the beam may be arrested easily by moving the lever, and the delicacy of the balance is increased by placing a weight upon the index, whereby the center of gravity is elevated. In this type of balance knife-edges are done away with entirely.

Liquids are measured by the use of graduated vessels of tinned copper or iron, agateware, and glass. For use in the practice of pharmacy glass measures are preferable, vessels of the other materials usually being used in measuring quantities larger than 1 pint. To measure small quantities of liquids, such as minims, glass vessels known as pipettes often are used because of the assurance of accuracy.

Pipettes are glass tubes with a constricted point and graduated on the side. They are used by applying suction to the upper end and holding the liquid in the tube by placing the finger on the upper end while reading off the contents. Owing to capillary attraction, the top of the liquid in a graduated pipette presents a cup shape. This is called a meniscus. A line drawn through the bottom of the meniscus usually is selected as the reading point.

A drop, through error, is supposed to be a minim; but though this may be approximately true when applied to water, it is not true in regard to other liquids. Thick viscous liquids produce large drops; heavy mobile liquids small ones. A drop of syrup of acacia is five times as large as a drop of chloroform. The size of a drop depends also upon the shape of the vessel from which dropped, upon the form of the lip, upon adhesion, cohesion, rapidity of flow, and viscosity. A drop of liquid from a curved eye-dropper is larger than one from a straight dropper having the same sized opening, because the straight one generally is held at an angle so that the drop falls from one side of the orifice, but with a curved dropper the drop falls from the whole circle of the orifice.

Specific gravity.

Specific gravity is the relative weight of equal bulks or volumes of different bodies. Water at a given temperature and atmospheric pressure is taken as the standard. The rules for taking specific gravity can be found in any reference or text book on pharmacy. Methods by which specific gravity may be taken are:

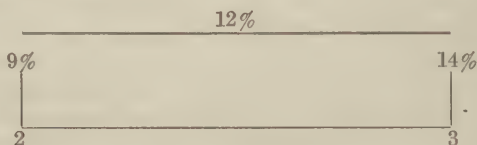
- (1) By the specific-gravity bottle.
- (2) By the use of Lovi's beads.
- (3) By the use of the hydrometer (water).
- (4) By the use of the lactometer (milk).
- (5) By the use of the alcoholometer (alcohol).
- (6) By the use of the urinometer (urine).

Specific volume.

Specific volume is the volume of one body compared with the volume of an equal weight of another body selected as a standard, both bodies having the same temperature. It is directly opposite to specific gravity. The temperature chosen is usually 25° C. (77° F.). To obtain the specific volume of bodies (or the space materials take up) divide the specific gravity of water (1.000) by the specific gravity of the liquid.

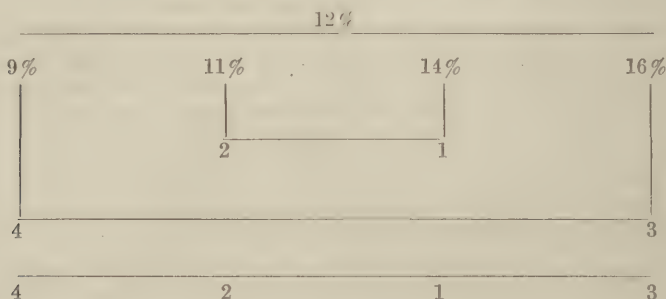
Pharmaceutical arithmetic.

Alligation, or the "rule of mixtures," is a process in arithmetic whereby may be ascertained the value or price of a compound by determining the relative proportions and prices of the ingredients. In pharmacy, the principles of alligation are used to determine the quantities of substances of different strengths necessary to be mixed so that a mixture of a given strength may be produced. As applied to pharmacy alligation sometimes is termed mathematical pharmacy. Unless one is familiar with mathematics alligation is not readily understood and soon is forgotten. Every problem of alligation can be solved if a line be drawn and the percentage wanted placed above, and the percentages necessary to use placed below, thus:



Nine is subtracted from 12, leaving 3, which figure is placed under the 14, and 12 is subtracted from 14, leaving 2, which figure is placed under the 9; therefore it takes 2 parts of a 9 per cent mixture and 3 parts of a 14 per cent mixture to make 5 parts of a 12 per cent mixture.

If necessary to use substances of three or four different percentages, the arrangements of a problem to prepare a 1,000 c. c. mixture of a 12 per cent mixture from a 9, 11, 14, and 16 per cent mixture would be:



By subtracting as before it is found that it would take 4 parts of 9 per cent, 2 parts of 11 per cent, 1 part of 14 per cent, and 3 parts of 16 per cent mixtures to produce a 12 per cent mixture. As 1,000 c. c. of the 12 per cent mixture are required, and it requires a total of 10 parts of the different mixtures, four-tenths of 1,000 c. c., or 400 c. c. of the 9 per cent; two-tenths of 1,000 c. c., or 200 c. c. of the 11 per cent; one-tenth of 1,000 c. c., or 100 c. c. of the 14 per cent; and

three-tenths of 1,000 c. c., or 300 c. c. of the 16 per cent mixtures are necessary; adding the number of c. c. of each percentage required gives 1,000 c. c.

To prove the above example proceed as follows: Multiply the number of parts used by the percentages, add the columns of parts and answers, and divide the larger by the smaller. The result of this division should be the percentage desired if the operations are correct.

$$\begin{array}{r}
 4 \times 9 = 36 \\
 2 \times 11 = 22 \\
 1 \times 14 = 14 \\
 3 \times 16 = 48 \\
 \hline
 10 \qquad) 120 (12 \\
 \qquad 10 \\
 \qquad \hline
 \qquad 20 \\
 \qquad 20 \\
 \qquad \hline
 \qquad 0
 \end{array}$$

A simple modification of alligation is that of percentage as outlined in the last pharmacopœia under alcohol, where the rule of dilution is given. To make 20 per cent alcohol from 95 per cent alcohol take 20 c. c. of 95 per cent alcohol and add enough water to make 95 c. c., when approximately 20 per cent alcohol is the result.

PHARMACEUTICAL PROCESSES.

Heat.

Heat is a form of radiant energy, due to molecular vibration, which produces the sensation called warmth. This molecular motion may be produced by friction, electricity, light, and chemical reaction. Heat is produced when alcohol and water are mixed, due to a chemical reaction in which a contraction of volume takes place, forming hydrates of alcohol; when sparks are obtained from a piece of flint and a steel, due to friction; when a burning glass ignites a substance by concentration of the rays of the sun, due to light; and when an electric current passes through wires having high resistance, as in an electric toaster, due to electricity. Heat may be produced by igniting coal, alcohol, kerosene, gasoline, wood, and illuminating gas. The latter frequently is used in a special apparatus known as a Bunsen burner, which permits the regulation of the flame by the admixture of air. The blue flame of a Bunsen burner is hotter than the luminous flame because heat is caused by oxidation and in the blue flame all the carbon is not oxidized, but is heated to the incandescent condition which produces light. The expression, "melting point" is used in pharmacy as a means of identifying a body or proving its purity. It is the temperature at which a substance melts or fuses.

Heat is measured and spoken of in degrees of temperature. By temperature is meant the sensibility of an object to the effects of heat. Temperature can not be measured in itself, so it is estimated by its effect on solids, liquids, and gases. Instruments used to measure temperature are known as thermometers or heat measurers.

A thermometer consists of a glass tube with capillary bore, sealed at one end, the other end terminating in a bulb. The bulb is filled with mercury or other fluid, which being expanded by heat, rises in the tube and indicates the degree of heat, either on an index scratched on the tube itself, or marked on a piece of paper against which the tube is placed.

Three scales are used in marking the degrees of a thermometer; they are centigrade, Fahrenheit, and Réaumur. The freezing point of water in the centigrade scale is zero; the boiling point is 100° . In the Fahrenheit scale water freezes at 32° ; the boiling point being 212° . In the Réaumur scale the freezing point is zero and the boiling point 80° . (Fig. 167.)

To convert centigrade degrees into Fahrenheit above 32, multiply by 1.8 and add 32. To convert Fahrenheit degrees above 32 into those of centigrade, subtract 32 and divide by 1.8.

In pharmacy there are several processes requiring the application of high heat, which are thus explained:

Ignition is the process of strongly heating solid or semisolid substances, the residue being the object sought.

Fusion is the process of liquefying solid bodies by the application of heat without the use of a solvent.

Calcination is the process of separating volatile substances from the fixed inorganic matter by the application of heat without fusion.

Deflagration is the process of heating one inorganic substance with another capable of yielding oxygen (usually a nitrate or chlorate). Used also in chemical test work.

Carbonization is the process of heating organic substances without the presence of air until the volatile products are driven off and the product resembles charcoal.

Torrefaction (roasting) is the process of modifying organic substances by the application of heat, but not enough to carbonize them.

Incineration is the process of strongly heating organic substances in the presence of air until all the carbon is consumed and an ash is the result. Used chemically in test work for the estimation of the total organic matter, the ash being the part sought.

Sublimation is the process of separating volatile solids from those nonvolatile or less volatile by vaporization and condensation.

Other operations in pharmacy require the use of heat until matter assumes the form required. These are described under the various terms, such as evaporation, distillation, desiccation, exsiccation, granulation, and sublimation, which are explained as follows:

Vaporization or evaporation is the process of separating volatile bodies from less volatile bodies by the aid of heat at varying temperatures, the fixed part being the object sought.

Distillation is the process of converting a liquid into a gas by vaporization and condensing the gas back into a liquid; in other words, distillation is the evaporation of a liquid and condensation of its vapor. Separation of a liquid from a solid by vaporization and condensation also is known as distillation. The apparatus required for distillation consists of a boiler in which vaporization takes place, and the condenser, in which the vapors are chilled until they become liquid in form. This combination is called a still. In making distilled water the first 10 volumes and the last 15 volumes should be thrown away, as they hold in solution practically all the gases that were in solution before distillation. Ordinary water contains ammonia, carbon dioxide, inorganic matter, and bacteria; therefore distilled water should be used in filling prescriptions.

Fractional distillation is the process of gradually separating, by distillation, the liquids forming a mixture and collecting the condensed vapors coming over

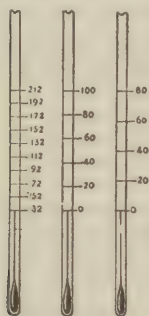


FIG. 167.—Thermometers; from left to right, Fahrenheit, Centigrade, Réaumur. (Remington.)

in portions or fractions as the temperature increases. Example: Separation of alcohol from water.

Destructive distillation is the process of decomposing solid organic substances, such as wood or coal, by heating in a closed vessel and collecting the volatilized products resulting. Air must be kept out of the vessel or combustion will occur. Example: Methyl alcohol, acetic acid, creosote, etc., from wood; illuminating gas, coal tar, etc., from coal.

Desiccation (drying out) is the process of depriving solids of moisture and at as low a temperature as possible. The objects of desiccation are:

- (1) To aid in preservation;
- (2) To reduce the bulk; and
- (3) To aid in grating, grinding, or powdering.

Exsiccation is the process of depriving a solid crystalline substance of its water of crystallization or moisture by the use of strong heat.

Granulation is the process of heating the solution of a chemical substance, with constant stirring, until the moisture has evaporated and a coarse-grained powder is produced.

The following pharmaceutical operations do not require the use of heat:

Comminution is the process of tearing drugs to pieces or reducing them to powder. This is done by cutting, rasping, grinding, powdering, grating, chopping, bruising, rolling, stamping, triturating, levigating, elutriating, and granulating.

Several of the instruments used in the process mentioned above are the pruning knife and shears, the herb cutter, the half-round rasp for

grating; the iron pestle and mortar for bruising; the drug mill for grinding.

Trituration is the process of rubbing substances to fine particles, usually with a mortar and pestle. (Fig. 170.)

The fineness of powders is spoken of and powders are known as very fine, fine, moderately fine, moderately coarse, and coarse; and powders also are known by numbers indicating the fineness of division, 80, 60, 50, 40, and 20, respectively. When powder is spoken of as a No. 80 powder, it is understood that this powder must pass through a sieve which has 80 meshes to the linear inch, and is classed as a very fine powder; the same is required and understood for the other numbers, as specified in the United States Pharmacopœia.

Levigation is the process of reducing a powder to finer particles than can be attained through trituration, and is accomplished by placing a substance on a slab, moistening with a few drops of a liquid, and rubbing over the slab with an instrument known as a muller. The muller is rotated in a circular motion as if drawing the figure 8. If the muller is made of porphyry, the process is called porphyzation.

Elutriation is the process of obtaining a substance in a fine powder by suspending it in water and allowing the heavier particles to subside and decanting the supernatant liquid and collecting the residue.

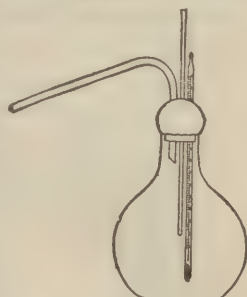


FIG. 168.—Distilling flask. (Remington.)



FIG. 169.—Spatulas. (Remington.)

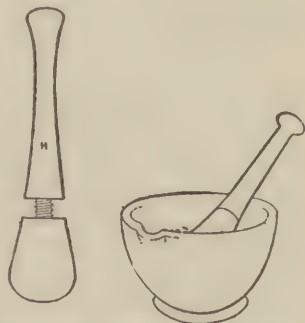


FIG. 170.—Pestle, hard rubber handle. Wedgewood mortar and pestle. (Remington.)

It sometimes happens that to reduce a substance to a powder another substance must be used, afterwards removing the foreign substance in a suitable way. An instance of this process, called pulverization by intervention, is the powdering of camphor, which is done by the addition of a few drops of alcohol, afterwards removing the alcohol by evaporation.

Solution.

A solution is a permanent and complete incorporation of a solid or gaseous substance with a liquid. The substance dissolved is called a *solute*, the product a *solution*, and the liquid used a *solvent*. If the solvent will dissolve no more of the substance, the product is called a *saturated solution*. Solutions are of two kinds, *simple* and *chemical*.

In a simple solution no change occurs in the chemical structure of the dissolved substance, as in the case of sugar dissolved in water.

In a chemical solution a change does take place in the chemical structure of the dissolved substance, as in the case of the preparation of solution of nitrate of mercury, when red mercuric oxide is dissolved in a mixture of nitric acid and distilled water, with the result that the mercuric oxide is changed to mercuric nitrate.

The making of solutions may be hastened by pulverizing the substance, by agitation, and also by heat.

Saturated solutions, although saturated with one substance, still may act as solvents for other substances.

As a rule, simple solutions lower temperature and chemical solutions raise temperature.

Stock solutions of mercuric chloride should contain a little ammonium chloride, as it prevents the reduction that slowly takes place in a solution of pure mercuric chloride. The ammonia makes it more soluble because a double compound is formed. Potassium iodide should not be kept long in stock solutions, as iodine is liberated.

Eye washes and hypodermic solutions should be filtered to be sure that no solid matter is left that would cause irritation.

Of the solvents used in pharmacy, water is the first and most important. Other solvents used are alcohol, glycerin, ether, benzin, chloroform, carbon bisulphide, acids, and oils.

Separation of fluids from solids.

Some of the processes in pharmacy used to separate fluids from solids are lotion, decantation, colation, filtration, clarification, expression, percolation, etc. They are explained as follows:

Lotion is the separating of soluble matter from a solid by pouring a liquid upon it, which dissolves and washes out the soluble portion.

Decantation is the separating of a liquid from a solid by pouring off the liquid. Sometimes this is effected by the use of a siphon.

Colation (straining) is the separating of a solid from a liquid by pouring the mixture upon a cloth or other porous substance, which permits the fluid to pass through but retains the solid.

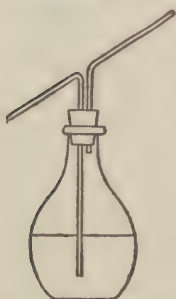


FIG. 171.—Spritz bottle. Used in the washing of a precipitate. (Remington.)

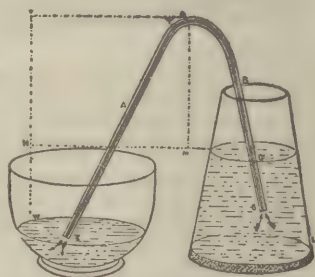


FIG. 172.—Siphonage. (Remington.)

Filtration is the separating of a liquid from a solid with the view of obtaining a transparent liquid.

One of the most important substances used as a filter is paper, which is used to a great extent in pharmacy, but other substances are employed as filters as required in certain conditions. These are sand, asbestos, charcoal, talc, etc. Filter papers are known as plain and plaited, the plain ones being used for retaining and washing the precipitate, and the plaited ones for ordinary operations.

In making most official waters purified talc is used, because it enables the volatile substances to be broken into minute particles, thereby increasing the surface exposed to the solvent action of the water, and removes the excess of the volatile substance, making a clear solution. Talc is not soluble appreciably in water or other liquids. Magnesium carbonate is objectionable as a substitute for talc, because the commercial article contains some hydroxide, which is somewhat soluble in water, thus making a solution that is sufficiently alkaline to cause the formation of a precipitate when metallic or alkaloidal salts are added to the water. Again, magnesium carbonate combines with the acids that normally are present in some of the oils, forming soluble compounds which may give colored preparations.

Clarification is the process by which, without the use of a strainer or filter, solid substances which interfere with their transparency are separated from liquids. It may be effected in the following ways: By the application of heat; by the addition of water; the use of albumin, gelatin, and milk; by fermentation; the use of paper pulp; and by long standing, when the solid substance settles to the bottom of the container and is known as a *sediment*. This method of clarification sometimes is called *sedimentation*.

A *sediment* is the solid matter separated by the action of gravity alone from a liquid in which it has been suspended.

Precipitation is a process of separating solid particles from a solution by the action of heat, light, or chemical substances and is also a method used in testing chemicals. The *precipitate* is the separated solid. The added liquid causing the

precipitate is the *precipitant*. The liquid remaining is called the *supernatant liquid*. The objects of precipitation are:

- (1) To obtain solid substances in a fine powder;
- (2) To purify solids;
- (3) To obtain through chemical reaction substances which are insoluble in the supernatant liquid.

Percolation is a process whereby a powder contained in a suitable vessel is deprived of its soluble constituents by the descent of a solution through it. It also is called the process of displacement because it was first observed that ether poured on powdered bitter almonds displaced the fixed oil which it contained without materially mixing with it. Percolation is used in pharmacy for extracting the virtues of drugs in the preparation of tinctures, fluid ex-

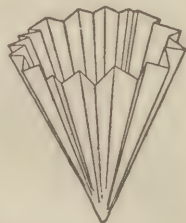


FIG. 173.—Folded filter. (Remington.)

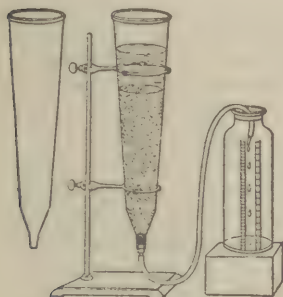


FIG. 174.—Official percolator on left and process of percolation. (Remington.)

tracts, etc. The container used is called a *percolator*, which is a cylindrical vessel with a porous diaphragm below, into which the drug in the form of powder is introduced, and its soluble portions extracted by the descent of a solvent through it. This solvent is termed the *menstruum*. The liquid coming from the percolator, impregnated with the soluble principles of the drug, is called the *percolate*. Each succeeding portion of the percolate is less highly colored and contains less of the active principles of the drug than the preceding percolate because the first portion of menstruum, in its descent through the powder, has the greatest opportunity to come in contact with the largest portions of the soluble principles. These soluble principles are found in the finer dust scattered through the powder and in the thoroughly disintegrated particles which offer but slight resistance to the passage of the menstruum.

Crystallization.

By crystallization is meant the formation of crystals. Most substances as they pass from a liquid or gaseous condition to a solid state assume regular geometric forms, which are bounded by plane faces and definite angles, and are the outcome of the disposition of molecules of the same substance always to assume the same regular shape. These forms are called crystals, and the study of crystals is crystallography. Some bodies do not crystallize, and these are spoken of as

amorphous, which means shapeless or without definite form, examples of such substances being chalk, acacia, etc. Crystals may be obtained in several ways and usually have a tendency to split or cleave in one direction more than another. Six systems of crystals, each different from the others and each having several subdivisions, are recognized. These systems are based upon the different general characteristics assumed by crystals.

In crystallization many substances contain water in combination with the crystal, and this water is spoken of as *water of crystallization*.

Bodies containing water of crystallization generally are spoken of to-day as *hydrated*, and use of the term "water of crystallization" is being dropped.

When crystals lose this water of crystallization and form a powder on the outside they *effloresce*; those that absorb water are said to be *hygroscopic*, but when they absorb sufficient water to liquefy they are said to *deliquesce*. After the crystals have been formed the liquid remaining is known as the *mother liquor*.

Some substances in crystallizing form masses of crystals and in the process mechanically imprison water in the interstices between the crystals. Such imprisoned water is known as *interstitial water* and may be freed by crushing the mass or gently heating it.

It is sometimes necessary to separate crystallizable from noncrystallizable substances, and the means or process taken to separate them is known as *dialysis*. The vessel used for this operation, called a *dialyzer* (Fig. 175), has a drumlike head or diaphragm made of porouslike membrane at one end; into this the substances to be separated are placed in the form of a solution and the whole floated on water where the crystallizable substance passes through the drum head into the water below, leaving the noncrystallizable substances behind. This operation is spoken of in pharmacy as "by osmosis" or passing through.

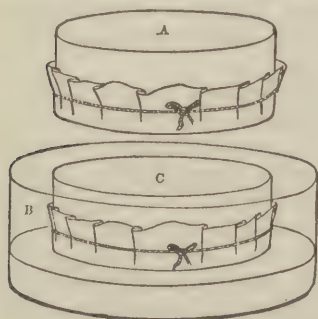


FIG. 175.—Dialyzer. (Remington.)

The substances which are crystallizable are called *crystalloids*, and those which are not crystallizable are called *colloids*. Thus it is seen that the object of this process is to obtain either the crystallizable or noncrystallizable substance free from the other.

Extraction is the art of separating the soluble principles from drugs by treating them with a liquid in which the principles are soluble. The solvent is called a *menstruum*. There are several methods of extraction which commonly are known as maceration, expression, percolation, digestion, infusion, and decoction. *Maceration* is the soaking of a drug in a solvent until the soluble portions dissolve. *Expression* is the process of forcibly separating liquids from solids. To accomplish this presses are employed. Presses are known as spiral twist, screw, roller, wedge, lever, and hydraulic, according to the mechanical principles involved in their action. *Digestion* is maceration with gentle heat. *Infusion* is the making of liquid preparations by pouring hot or cold water over the drug and allowing the drug to macerate the specified time. *Decoction* is the making of liquid preparations by boiling the drug for 15 minutes or longer with water.

FORMS OF PHARMACEUTICAL PREPARATIONS DIRECTED BY THE UNITED STATES PHARMACOPŒIA.

In applying those processes in pharmacy which have been described to the manufacture of pharmaceutical preparations, pharmaceuticals are divided into two classes known as *galenic preparations* and *chemical preparations*. Galenic preparations are those in the manufacture of which no chemical action is involved, and chemical preparations are those in which chemical change occurs during their manufacture. Chemical change occurs in the making of some galenic preparations, and some chemical preparations can be made by galenic means, but for convenience in studying pharmaceutical preparations the division into these two classes is customary.

Official pharmaceutical preparations are grouped further in two general classes showing the nature of the preparation. These are liquids and solids.

Liquid preparations are those in which the medicinal substance is contained in various liquid bases, and solid preparations are those in which the medicinal substance is incorporated in a solid or semisolid base.

Liquid preparations also are grouped in classes according to the nature of the principal bases used in their manufacture, i. e.:

Acetone preparations.	Ethereal preparations.
Acetous preparations.	Glycerine preparations.
Alcoholic preparations.	Oleaginous preparations.
Aqueous preparations.	

Solid preparations are grouped in classes according to the nature of the preparation, i. e.:

Cerates.	Powders.
Extracts.	Resins.
Masses.	Suppositories.
Ointments.	Triturations.
Plasters.	Troches.
Pills.	

In addition to the above there are *natural preparations*, some of which are alkaloids, glucosides, and other neutral principles, acids, alkalies, etc.

Both liquid and solid preparations may be made with maceration and percolation or without maceration and percolation.

Liquid preparations.

Aceta (*vinegars*) are liquid preparations obtained by extracting the active principles of drugs by maceration or percolation with vinegar or dilute acetic acid. Acetic acid is used because it is a good solvent, is a preservative, and possesses antiseptic properties. Though the use of vinegars dates back to the time of Hippocrates, they have been supplanted by the use of the tincture and fluid extract, and there now is left but one official vinegar, i. e., vinegar of squill.

Aqua (*waters*) are aqueous solutions of volatile substances. There are 20 official waters.

There are various methods of preparation, viz.: Simple solution in cold water by agitation (example, aqua chloroformi); by passing gases through water (example, aqua ammoniac); solution in hot water; filtration through an absorbent powder (example, aqua cinnamomi); filtration through pulp or shredded paper; percolation through cotton impregnated with the substance; distillation (example, aqua hamamelidis).

A jug is better than a bottle in making flavoring waters by mixing oil with hot water, as the rough surface of the jug helps to break up the oil. Cinnamon water may become acid because the oil contains cinnamic aldehyde, which slowly oxidizes to cinnamic acid.

Ammonia water is used in making aromatic spirits of ammonia for its therapeutic effect, and also to convert the ammonium bicarbonate into the normal carbonate, so that it will be soluble in alcohol. The United States Pharmacopœia directs the use of ammonium carbonate in "translucent pieces" so as to get the requisite amount of salt. Opaque pieces have lost ammonia and carbon dioxide and consist of ammonium bicarbonate. Aromatic spirit of ammonia is set aside for 12 hours in order to allow time for the ammonium hydroxide to act on the ammonium bicarbonate and change it to the carbonate. Aromatic spirit of ammonia turns dark on keeping for some time, because the alcohol frequently contains some aldehyde and other impurities which are darkened by ammonia; then the gradual increase in color is due to the action of ammonia on the oils.

In mixing sulphuric acid and water the acid should be poured into the water, not the water into the acid, as there is less heat, less steam generated, and less danger of accident. Sulphuric acid and water when mixed produce heat, due to chemical reaction, and contraction of the total volume occurs. Sulphuric acid when dropped on organic matter (as wood) blackens it, because the acid abstracts the elements of water and leaves carbon.

Lime, when mixed with water, produces heat, because a chemical reaction takes place, forming calcium hydroxide.

Collodia (*collodions*) are liquid preparations intended for external use having a solution of pyroxylin or guncotton for a base in a mixture of ether and alcohol. There are three official collodions.

Elixiria (*elixirs*) are aromatic, sweetened, alcoholic preparations containing small amounts of active medicinal substances. Elixirs are made with a menstruum of alcohol and water and there are two official.

Emulsa (*emulsions*) are soft liquid preparations resembling milk, and consisting of an insoluble substance of an oily or resinous nature suspended in water by means of gum, yolk of egg, or other viscid matter. There are four official emulsions.

There are two types of emulsions used in pharmacy, the oil-in-water type and the water-in-oil type. Almost all emulsions which are intended for internal use, such as cod-liver oil, etc., belong to the first type, where the oil droplets coated with a film of hydrated acacia are suspended in water. The film around the droplets prevents their running together. Preparations like hydrous wool fat, carron oil, etc., intended for external use are emulsions of the water-in-oil type, in which water, in the form of droplets, is suspended in oil. Emulsions are unstable and should be freshly prepared when desired. Milk, various plant juices, and the emulsions resulting when asafetida, myrrh, etc., are triturated with water, are termed natural emulsions.

Fluidextracta (*fluid extracts*) are concentrated alcoholic preparations of vegetable drugs made by percolation, representing in each cubic centimeter the activity of one gram of the drug. In other words, they are 100 per cent tinctures. There are five general processes for the manufacture of fluid extracts:

- (1) Percolation with partial evaporation.
- (2) Fractional or divided percolation.
- (3) Repercolation.
- (4) Percolation with complete exhaustion.
- (5) Maceration with hydraulic pressure.

The United States Pharmacopœia gives general pharmacopœial formulas called "type processes." Types "A" and "B" are methods of percolation with partial evaporation, the only difference being whether or not the menstruum contains glycerin. Type "C" is percolation without evaporation and type "D" directs the preparation of an infusion or decoction of the drug and addition to it of sufficient alcohol to preserve it. Examples of each process are:

Type "A" process, fluid extract of belladonna root.

Type "B" process, fluid extract of ipecac.

Type "C" process, fluid extract of aconite.

Type "D" process, fluid extract of cascara sagrada.

As a rule fluid extracts keep well; the precipitate, often occurring, almost invariably is inert. It must be borne in mind that in some cases the precipitate in fluid extracts contains a valuable constituent, and in such cases the precipitate should be retained. As there is no table showing which should be retained or rejected, it is customary to dispense fluid extracts in clear form.

The United States Pharmacopœia, eighth revision, gave 85 official fluid extracts; in the ninth revision there are monographs for 49. Those deleted are recognized by the National Formulary.

Glycerita (*glycerites* or *glyceroles*) are mixtures or solutions of medicinal substances with glycerin. Glycerite of starch is not a solution but a semisolid mass. There are five official glycerites.

Infusa (*infusions*) are aqueous preparations of vegetable drugs and, unless otherwise directed, represent 5 per cent of the drug. Boiling water is used in making infusions. There are two infusions official, varying in strength from $1\frac{1}{2}$ to 6 per cent.

Linimenta (*liniments*) are thin, oleaginous preparations for external use, applied by friction. Not all liniments contain insoluble matter, some are clear alcoholic solutions, such as soap liniment; some are clear oleaginous solutions, such as camphor liniment; turpentine liniment is more or less a transparent semi-solid mass; ammonia and lime liniments are opaque. There are eight official liniments.

Heat is used in making camphor liniment to aid the solution of camphor and the camphor dissolves more quickly if coarsely powdered. Powdered or granu-

lar soap is preferable to bar soap in making soap liniment, as it is more constant in the amount of water it contains. Soap liniment should be allowed to stand 24 hours before filtering, so that the sodium palmitate contained in the soap (which goes into solution at first, but afterwards precipitates) may be filtered out.

Chloroform liniment sometimes separates into two layers because an excess of water or a deficient amount of alcohol was used in making the soap liniment. With the present formulas, however, this is hardly liable to take place. Ammonia liniment sometimes becomes solid because the ammonia acts on the oil and forms a soap. Lime liniment gets thick because a soap slowly forms.

Liquores (solutions) are aqueous solutions of nonvolatile substances. Liquors are divided into two classes according to the method of preparation: By simple solution and chemical aqueous solution. Twenty-five are official.

Liquor calcis is a simple solution; liquor ammonii acetatis is a chemical solution.

Magma (magma) are liquid preparations containing suspended insoluble, inorganic chemical substances in a finely subdivided state. There are two magmas official.

Mellita (honey) are thick liquid solutions of a syrupy consistency containing medicinal principles prepared by dissolving the medicinal ingredient in honey. The official name for honey is mel. There are three official honeys.

Mistura (mixtures) are liquids containing undissolved matter and insoluble nonfatty substances. Since they contain insoluble matter they must be dispensed with a "Shake well" label. There are two official mixtures.

Mucilagines (mucilages) are thick, viscid, adhesive liquids made by dissolving gum in water, or by extracting the mucilaginous principles in plants by means of water. They are made either with or without heat. Two mucilages are official.

Oleata (oleates) are solutions of metallic oxides or alkaloids in oleic acid. They are intended for external use and there is one official oleate.

Oleoresina (oleoresins) are liquid preparations of natural oils and resins extracted from vegetable substances by percolation with ether or alcohol.

There are two classes of oleoresins, natural and pharmaceutical. Natural oleoresins are mixtures of volatile oils and resin exuding from plants, such as copaiba, whereas pharmaceutical oleoresins are manufactured by placing the drug without moistening in a suitable apparatus and percolating with the appropriate solvent. This solvent then is distilled from the percolate, leaving a small quantity of oily liquids behind; this is the official oleoresin. Example: Oleoresin of aspidii (male form). There are six official oleoresins.

Spiritus (spirits) are alcoholic solutions of volatile substances. They are classified according to the method by which they are made, as, simple solution, solution with maceration, gaseous solution, chemical reaction and distillation. Fifteen spirits are official.

Syrupi (syrups) are preparations containing medicated or flavoring substances in a concentrated aqueous solution of sugar. A concentrated aqueous solution of sugar is called syrup, or simple syrup; if a pleasant fruit or aromatic flavor is added, it is termed a flavored syrup; while if the addition is of a medicinal character, the product is a medicated syrup. Simple syrup is made by the aid of heat and by the cold process.

An excess of iron over iodine is used in making syrup of iodide of iron, because if an excess of iodine were used it could not be removed by filtration as can iron. An excess of iron promotes the reaction and prevents oxidation,

The reaction in making syrup of iodide of iron is more rapid after some ferrous iodide has been formed, as the chemical reaction generates heat, and heat aids the reaction. Ferrous iodide dissolves iodine, changing it into a form that will react more readily with iron. Sometimes it is necessary to check this reaction, as the heat generated may crack the vessel or volatilize the iodine. In making the syrup of iodide of iron the mixture of iodine, iron, and water is heated to boiling before filtering so as to complete the chemical reaction. Sugar is added to solution of ferrous iodide before filtering, as it is a reducing agent and helps to prevent the oxidation of ferrous iodide. Hypophosphorous acid added to syrup of iodide of iron prevents oxidation and liberation of iodine. Syrup of iodide of iron becomes red as iodine is liberated gradually and dissolved, and caramelization of the sugar sometimes may take place. Direct sunlight prevents or retards the liberation of iodine in syrup of ferrous iodide and reduces it after it has been liberated. As air oxidizes syrup of iodide of iron, bottles containing it should be kept full.

Glycerine is used in syrup of ipecac to prevent souring. Potassium carbonate is used in syrup of rhubarb and aromatic syrup of rhubarb to prevent the precipitation of resinous matter by forming a soluble compound with it. There are 22 official syrups.

Glucose is prepared by the action of sulphuric acid on starch, and also may be obtained from candied sugar, grapes, and other sources. The term glucose is applied to the syrupy form; a solid form of glucose is obtainable and known under the terms of dextrose and grape sugar.

Tincture (tinctures) are alcoholic solutions of nonvolatile substances obtained by extraction of the drugs, with the exception of tincture of iodine, but the presence of potassium iodide, which is nonvolatile, in this tincture, brings it practically within the definition given.

There are 44 official tinctures, varying in strength from 0.4 per cent to 50 per cent, the majority being 10 per cent and 20 per cent. Those not included in the 10 or 20 per cent tinctures are:

	Per cent.
Tr. opii camphorata.....	0.4- 1
Tr. gambir composita.....	5
Tr. moschi.....	5
Tr. lavendulæ composita.....	5.5
Tr. iodi.....	6.5- 7.5
Tr. ferri chloridi.....	13
Tr. cardamomi.....	15
Tr. benzoini composita.....	24
Tr. aurantii dulcis.....	50
Tr. lactucarii.....	50
Tr. limonis corticis.....	50

They are made by several processes, which are as follows: Solution or dilution, maceration, digestion and maceration, percolation, and digestion and percolation.

Potassium iodide is used in tincture of iodine to aid solution of the iodine and prevent its precipitation when water is added to the tincture. Water is now used in tincture of iodine to dissolve potassium iodide, as it dissolves very slowly in alcohol. The use of decolorized tincture of iodine should be discouraged, as the title tincture is misleading, it being really a tincture of the iodides of sodium and ammonium, and not having the physiological effect of iodine.

Solid preparations.

Cerata (*cerates*) are unctuous substances and easily spread at ordinary temperature upon muslin or similar material with a spatula, but not so soft that they will liquefy and run when applied to the skin. They are called cerates on account of the presence of wax (*cera*). Substances used for bases are oil, lard, petroleum, wax, and sometimes paraffin or spermaceti in the presence of wax are used to raise the melting point of the bases. There are three official cerates.

Emplastra (*plasters*) are substances intended for external application. They are of tenacious but pliable consistence, adhere to the skin, and require the aid of heat in spreading them. They usually are spread on muslin, leather, or paper, and have lead plaster, a gum resin, or Burgundy pitch as a base. There are seven official plasters.

Extracta (*extracts*) are solid, semisolid, or powdered preparations obtained by evaporating solutions of vegetable substances. There are 24 official extracts. Extracts are made in two ways, by extraction of the dried and powdered drug with a solvent and by expression of the fresh moist drug, and then evaporating to a pilular consistence or to dryness. The United States Pharmacopœia recognizes two kinds of extracts, the pilular (solid or semisolid) and the powdered.

In some extracts a little glycerin is added to prevent hardening of the mass.

Massæ (*masses*) are combinations of medicines worked up with enough liquid to make solids of sufficient plasticity to roll into pills. There are two official masses.

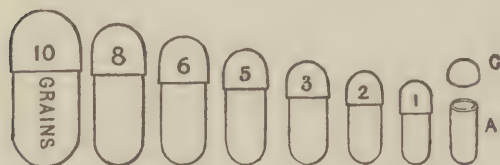


FIG. 176.—Empty capsules. (Remington.)

Pilulæ (*pills*) are small, solid bodies usually of a spherical shape, which are intended to be swallowed whole, and thereby produce medical action. Pills are composed of the active ingredients and the excipients. The mass must be adhesive, firm, and plastic. The excipients may be liquid or solid. The liquids used as excipients are water, syrup, acacia, mucilage of acacia, glycerin, glucose, honey, glycerite of starch, and glycerite of tragacanth; the solids used as excipients are confection of rose, bread crumbs, althea, soap, rosin cerate, cocoa butter, and petrolatum. There are seven official pills. To successfully make pills requires considerable experience and before proceeding reference to any standard practice of pharmacy should be had.

Pulveres (*powders*) are a class of preparations composed of finely powdered dry substances that when administered by the mouth are not repulsive to the sense of taste and not caustic or corrosive in their local action. There are seven official powders. A mortar and pestle usually are used in making powders. Powders frequently are dispensed in gelatin capsules.

Resinæ (*resins*).—The official resins are solid preparations consisting principally of resinous principles found in plants and usually precipitated from their alcoholic solutions by the use of water. There are four official resins.

Suppositoria (*suppositories*) are solid bodies containing medicinal substances of different weights and shapes, adapted for introduction into orifices of the human body, and melt easily at blood temperature. The vehicles usually used for suppositories are oil of theobroma, glycerinated gelatin, or sodium stearate. Suppositories should be of sufficient consistency to retain their shape when inserted and at the same time melt at the temperature of the body. They may be made by hand or by molds, of which there are three kinds—individual molds, divided molds, and liquid molds.

Cocoa butter makes the best suppository base, because it is solid at ordinary temperature, liquid at body temperature, and is a bland, soothing substance. Trouble is experienced in making suppositories of phenol, chloral hydrate, naphthalene, and similar compounds, because the oil is softened by these, and it may be necessary to add a hardening agent. Gelatin should not be used as a base for ichthyol suppositories, as it is not soluble with gelatin. Sodium carbonate and stearic acid are used in making glycerin suppositories as they react, making sodium stearate which will solidify a large amount of glycerin. Glycerin suppositories should be preserved in tight vessels because, being somewhat hygroscopic, they tend to become liquid on exposure to air.

Suppositories containing tannic acid are best made in the cold (not melting the base), because heat causes the acid to form tough, hard masses. The suppository of glycerin is the only one official.

Trochisci or *troches* (*lozenges*) are solid, small, flattened, or cylindrical masses, consisting chiefly of medicinal powders incorporated with sugar, mucilage, etc. Their preparation consists of making the ingredients into a mass, which is rolled into a thin sheet and then cut into proper shape with a lozenge cutter. There are five official troches.

Unguenta (*ointments*) are fatty mixtures of medicinal substances (softer consistency than cerates), with a base of lard, fixed oils, or petrolatum, and intended to be applied to the skin by inunction. They have a low melting point (due to less wax being used than in a cerate).

Ointments usually are made in two ways, by fusion and by incorporation. In fusion the fatty substances are liquefied by the aid of heat and the medicinal substance incorporated while the fats are liquid or after solidification, by incorporation the medicinal substance is rubbed up with the solid fatty matter, either in a mortar or on a slab.

An ointment base should not be rancid, not only because of the odor but the free acid is frequently irritating and may cause chemical reaction. Petroleum is a good ointment base in certain cases, because it is cheap, is not readily absorbed, consequently acting as a protective, and does not become rancid. Hydrous wool fat is a good ointment base, because it is readily absorbed, carrying with it the medicinal agent, and can be mixed with a large percentage of water or other liquid without losing its ointment properties, especially in making an ointment when liquids are called for which are not miscible with the prescribed base. The United States Pharmacopœia allows as much as 30 per cent of water in hydrous wool fat, as anhydrous wool fat is very tough and sticky and the presence of that amount of water gives it the proper consistency for an ointment base. As the anhydrous wool fat is good for making ointments containing a large amount of water or other liquids, it is recognized in addition to the hydrous wool fat.

Lard, because it is cheap, quite readily absorbed, and will mix with some water, is a good ointment base. Melted lard should be stirred and cooled quickly when used, as it is less likely to become granular. When lard is benzoinated the antiseptics dissolved out of the benzoïn retard rancidity.

Yellow wax is better for an ointment base than white wax, because in bleaching wax a change takes place which makes it more liable to become

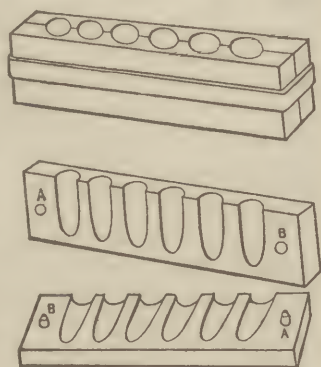


Fig. 177.—Suppository molds. (Remington.)

rancid. Paraffin is an objectionable substitute for wax in ointments, as it has a tendency to make the ointment granular.

Ingredients having high melting points should be melted before those having a lower melting point, as the high heat necessary to melt the former may be injurious to the latter. Ointments should be stirred when cooling, because the ingredients having high melting points usually will solidify first, resulting in a granular ointment.

Glycerite of starch makes a good ointment base in certain cases because it is not greasy and can be washed off without difficulty. In making ointment of boric acid it is stirred until congealed, as boric acid is not soluble in petrolatum and is held mechanically.

Glycerin is used in tannic-acid ointment to dissolve the acid and make it more effective. Metal spatulas should not be used in making tannic-acid ointment, as it attacks the iron, forming tannate of iron, resulting in a darkened ointment. If the spatula first is smeared with the fatty substance, there is little danger.

In making cold cream (ointment of rose water) rose water is used instead of oil of roses to perfume it, as the water makes it softer and more creamy. Ointment of rose water is stirred for some time because the longer it is stirred the whiter it becomes. Borax is used in cold cream to give a whiter and more creamy preparation. Water is warmed in making cold cream, because if not warmed it may chill the melted base and make it lumpy or granular. Many cold creams are made with paraffin and liquid petrolatum, as it is a cheaper base and one that does not become rancid.

In making belladonna ointment the extract is rubbed with dilute alcohol to thoroughly soften the extract so as to make a homogeneous mixture. Wood fat then is used to take up the liquid.

Oleate of mercury is used in making mercurial ointment because it will hold mercury in a microscopic state of subdivision. Mercurial ointment should be kept in a cool place, as the mercury separates out when warmed. A metal spatula should not be used in handling citrine ointment, as the ointment is acid and attacks iron. Citrine ointment sometimes becomes dark colored when mixed with an alkali because the mercury has been partly reduced to the mercurous condition and the alkali causes the black oxide to be formed.

Lanolin is better for making oxide of mercury ointment than the simple ointment, as the mercury oxide is not reduced readily.

Potassium iodide is used in iodine ointment, as iodine can not be reduced to an impalpable powder, but is very soluble in a glycerin solution of potassium iodide, and this solution can be mixed intimately with the base. Glycerin is used in iodine ointment to dissolve the potassium iodide. Water is objectionable because it evaporates and the iodide is left in gritty crystals.

Natural preparations.

Acids, from a medical standpoint, are medicines which in concentrated form act, usually as caustics, to destroy tissues. From the vegetable kingdom the principal acids derived are acetic, citric, and benzoic, and from the mineral kingdom nitric, phosphorous, sulphuric, and hydrochloric.

Alkalies (antacids) are agents which neutralize acids, acts as escharotics on tissue, and, when in contact with the mouth of the duct of the glands producing them, are supposed to check alkaline and stimulate acid secretions. The chief members of this group are sodium, potassium, ammonium, calcium, magnesium, and lithium.

Alkaloids are active, nitrogenous principles existing in plants and extracted from them by chemical art. They are organic bases and form salts with acids.

There are 23 official alkaloids, under either their own names or those of their salts, including pöletierine and veratrine, which are mixtures of alkaloids. Their official Latin titles end in "ina," the English in "ine."

Glucosides are organic compounds belonging to the group of neutral principles which exist in plants and which, by the action of reagents or natural ferments, split up into glucose or a related carbohydrate and some other body. Their official Latin titles end in "inum," the English in "in." There are two official glucosides, but a number of drugs containing glucosides (glucosidal drugs) are official. Besides glucosides there are several other natural principles whose names terminate in "inum" and "in" but have no relationship to the group of glucosides.

Essential or volatile oils are those substances found in the blossoms, flowers, and fruits of plants which usually contain odorous principles. They may exist in the plant or be produced by the reaction of certain constituents when brought in contact with water. They sometimes are formed through destructive distillation and may be obtained from the animal kingdom. While rapidly being displaced by a more correct classification, essential oils customarily are grouped in four classes, known as the terpenes, oxygenated oils, nitrogenated oils, and sulphurated oils. A point of differentiation between volatile oils and fixed oils is that the former leave no stain behind after gently evaporating a drop of the oil placed on filter paper. Essential oils are used principally in the manufacture of perfumes and cosmetics.

Fixed oils and fats are obtained from both the vegetable and animal kingdoms. When touched they leave a greasy feeling on the fingers, they are insoluble in water, and leave a permanent oily stain on paper. Nearly all fixed oils and fats are natural combinations of glycerin with stearic, oleic, and palmitic acids, and they are extensively used in the manufacture of soaps.

Soaps are products made by boiling oils and fats with a solution of some caustic alkali until a thick mass is formed, glycerin being set free.

Unsaponifiable fats are official fats which can not be classed with either the fixed or volatile oils, yet which in some respects partake of the properties of both. Petrolatum in its several forms, paraffin, petroleum, benzin, and the products of petroleum belong to this group.

PREScriptions.

A prescription is a formula which a physician writes, specifying the substance he intends to have administered to a patient. It is written in Latin because it is the official language of science, is understood throughout the world, and, being a dead language, is not subject to change.

The parts of a prescription are:

- (1) Name of patient and date.
- (2) Superscription, indicated by the symbol "℞," standing for the Latin word *recipe* (take thou).
- (3) Inscription, expressing the name and quantities of the ingredients, viz., the base, the adjuvant, the corrective, and the vehicle.
- (4) Subscription, directions to the pharmacist.
- (5) Signature or transcription, directions to the patient, ending with the prescriber's name.

MODEL PRESCRIPTION.

℞ For John Jones	3/15/23
Sodii bromidi	16 gm. (5i℥)
Antipyrinæ	8 gm. (3i℥)
Liquor acidi arsenosi	4 c. c. (f5i)
Aquæ menthæ piperitæ-q. s. ad.	120 c. c. (f3iv)
Misce et signa: One teaspoonful in water three times daily after meals.	

John Doe, M. D.

In filling prescriptions note carefully the dose of all medicines prescribed, because the physician is human and is liable to make an error. In law the pharmacist, as well as the physician, is held responsible in case of an overdose, and suit for damages is more likely to be brought against the pharmacist than the physician.

The words "Use as directed" should be avoided by the prescriber, as the patient is generally in a more or less nervous condition and likely to forget the details; then, too, by having the directions of the prescription it makes another safeguard in that pharmacists can detect an error more readily if one is present. Upon the dose depends the safety.

In filling prescriptions requiring the mixture of an insoluble substance with a liquid, it is preferable to rub it in a mortar with a small amount of liquid, because if the solid is put simply into a bottle and shaken the substance may "lump" and require time and agitation in order to get it mixed. This is particularly true with calomel, magnesia, sulphur, or a vegetable drug.

TABLE OF PRINCIPAL LATIN WORDS USED IN PHARMACY, WITH CONTRACTION AND MEANING.

Term or phrase.	Contraction.	Meaning.
Ad.....	Ad.....	To, up to.
Ad conedlandum gustum.....	Ad.....	To suit the taste.
Addo, addantur.....	Add.....	Add, let it be added.
Ad libitum.....	Ad lib.....	At pleasure.
Albus.....	Alb.....	White.
Alternis horis.....	.....	Every other hour.
Ana.....	a. a., A.....	Of each.
Ante cibum.....	A. c.....	Before eating.
Aqua bulliens.....	Aq. bull.....	Boiling water.
Aqua communis.....	Aq. comm.....	Common water.
Aqua fervens.....	Aq. ferv.....	Hot water.
Bene.....	.....	Well.
Bis.....	.....	Twice.
Bis in die.....	Bis in d., B. i. d.....	Twice a day.
Capiat.....	Cap.....	Let him (or her) take.
Charta.....	Chart.....	Paper.
Cibus.....	.....	Food.
Cochlear or cochleare, Cochleatim.....	Coch., Cochleat.....	A spoonful, by spoonfuls.
Cochleare amplum.....	Coch. amp.....	A tablespoonful.
Cochleare magnum.....	Coch. mag.....	A large spoonful (about half an ounce).
Cochleare medium or modicum.....	Coch. med.....	A dessertspoonful (about 2 fluid drams).
Cochleare parvum.....	Coch. parv.....	A teaspoonful (about 1 fluid dram).
Cola.....	Col.....	Strain.
Collunarium.....	.....	A nose wash.
Collutorium.....	Collut.....	A mouth wash.
Collyrium.....	Collyr., Col.....	An eye wash.
Congius.....	Cong.....	A gallon.
Contra.....	.....	Against.
Cortex.....	Cort.....	The bark.
Cum.....	C.....	With.
Dividatur in partes aequales.....	D. in p., aq.....	Let it be divided into equal parts.
Eadam (fem).....	.....	The same.
Ejusdem.....	EjUSD.....	Of the same.
Et.....	And.....	And.
Fac., fat.....	F., ft.....	Make, let it be made.
Piant chartule xii.....	Ft. chart. xii.....	Make 12 papers.
Piant pilule xii.....	Ft. pil. xii.....	Make 12 pills.
Piant pulveres xii.....	Ft. pulv. xii.....	Make 12 powders.
Piant secundum artis regulas.....	F. S. A. R.....	Let it be made according to the rules of art.
Piant solutio.....	Ft. solut.....	Make a solution.
Filtra.....	.....	Filter (thou).
Flavus.....	Flav.....	Yellow.
Gargarisma.....	Garg.....	A gargle.
Gutta.....	Gtt.....	A drop.
Guttatim.....	Guttat.....	By drops.
Idem.....	.....	The same.
Misce.....	M.....	Mix.
Non.....	.....	Not.
Non repetatur.....	Non rep.....	Do not repeat.
Octarius.....	O.....	A pint.
Partes aequales.....	P. a.....	Equal parts.
Post cibum.....	P. c.....	After eating.
Pro re nata.....	P. r. n.....	Occasionally, as needed.
Pulvis.....	Pulv.....	A powder.
Quantum sufficiat, Quantum satis.....	Q. S.....	As much as is sufficient.
Recipe.....	R.....	Take (thou).

TABLE OF PRINCIPAL LATIN WORDS USED IN PHARMACY, ETC.—Continued.

Term or phrase.	Contraction.	Meaning.
Secundum artem, Secundum naturam.	S. a., S. n.	According to art, according to nature.
Semis.	Ss.	A half.
Signa.	Sig.	Mark thou.
Solve.		Dissolve.
Supra.		Above.
Ter in die.	T. i. d.	Three times a day.
Ultimo (or ultima) præscriptus.	Ult. præsc.	The last ordered.
Uncia.		An ounce.
Ut dictum.	Ut Dict.	As directed.

INCOMPATIBILITY.

Incompatibility is a condition in which drugs used in pharmaceutical mixtures will not combine, produce new compounds, or are therapeutically opposed. These conditions are known as pharmaceutical, chemical, and therapeutic incompatibility.

Chemical incompatibility is chemical action resulting in the decomposition of one or more of the ingredients entering into the prescription. It may result in precipitation, production of a gas, change in color, or explosive poisonous compounds, and is sometimes intentional. Examples: Alkaloids will be precipitated from their solution by tannic acid, alkalies, carbonates, iodine or iodides, phosphates, boric acid, and borates. Explosive compounds will result from mixing powerful oxidizing agents with others which are readily oxidizable, such as nitric, free hydrochloric, and nitrohydrochloric acids, potassium chlorate, or potassium permanganate with glycerin, sugar, alcohol, oils, ethers, tannin, sulphur, sulphides, phosphorous, and hypophosphites. Glucosides are decomposed with substances containing emulsin. Iron salts with tannic acid or drugs containing tannin produce inky mixtures.

Pharmaceutical incompatibility is the condition arising from mixture of pharmaceutical preparations which result in the physical dissociation of one or more constituents, but without chemical action. Examples: Tincture of chloride of iron added to syrup of acacia will gelatinize; fluid extracts diluted with liquids differing from those used in the fluid extracts cause the gum, albumin, resin, or mucilage to separate. Water is the solvent for albuminous, gelatinous, gummy, and saccharine bodies and for a large number of inorganic salts, while alcohol is the solvent for volatile oils and resins, gumresins, resinoids, balsams, and all drugs containing these substances as their active principles. The solvent power of either alcohol or water for the particular substance decreases in proportion to the amount of one added to the other.

Therapeutic incompatibility occurs when two agents antagonistic to each other in their action on the human system are given together. Examples: Belladonna in any form with physostigmine; a solution of bromide of potash with strychnine; opium with caffeine; solutions containing pepsin with alkalies or pancreatin with acids.

In many cases physiological antagonists intentionally are given together so that one will act as a guard against the excessive action of the other, as the use of morphine with atropine.

THE HARRISON NARCOTIC LAW.

The Harrison narcotic law, enacted by the United States Congress December 17, 1914, provides that on or after March 1, 1915, every person who produces,

CHAPTER VIII.

MATERIA MEDICA.¹

GENERAL CONSIDERATIONS.

Used in the treatment of disease are many substances obtained from the animal, vegetable, and mineral kingdoms. These substances generally are spoken of as medicines and in studying them it is necessary to consider their source, composition, physical characteristics, chemical properties, preparation and administration, and physiological and toxicological action. The science which treats of the substances used as medicines is *materia medica*.

That particular science which relates to the properties of medicinal substances and the application of remedial agents in the treatment of disease is known as *therapeutics*. In addition to the use of drugs as remedial agents, electricity, water, serums and vaccines, light rays, heat, physical, mechanical, and operative measures, and hygienic agents are employed for curative purposes. Therapeutics is divided into three classes known as *rational*, which is based upon known laws of the remedies and the diseases, *empirical*, based entirely on the results of clinical observation and experience, and *general*, when remedial agents other than drugs or medicines are used.

Medicines may be divided into two general groups—*stimulants*, which increase the functional activity of the body or of any organ or tissue, and *sedatives*, which lessen or reduce the functional activity and, according to their composition, are inorganic or organic.

The various preparations of drugs or the different forms in which they may be used and the names given to substances of vegetable origin have been discussed in the chapter on Pharmacy.

Medicinal substances usually are described according to their actions and effects on the body or its organs and tissues, and following is a list of the terms used, with definitions of the therapeutic action of each.

Alteratives: Medicines used to modify nutrition so as to overcome morbid processes.

Analgesics or Anodynes: Medicines used to allay pain.

Anaesthetics: Drugs used to produce local or general insensibility.

Anaphrodisiacs: Medicines which depress the sexual appetite and function.

Anhydrotics: Medicines which are used to diminish perspiration.

Antacids: Medicines used to neutralize acid in the stomach and intestines.

Anthelmintics: Medicines used to destroy or expel intestinal worms.

Antidotes: Medicines or agents which act upon poisons in such a manner as to alter their composition, rendering them less poisonous, and so preventing their toxic action from being exerted upon the organism.

Antiemetics: Medicines used to arrest vomiting.

Antiperiodics: Medicines used for the relief of periodically recurring diseases, such as malaria.

Antiphlogistics: Medicines or agents which reduce or dissipate inflammation.

Antipyretics: Medicines used in the reduction of body temperature in fevers.

¹ Prepared by Chief Pharmacist E. G. Swann, United States Navy.

Antiseptics: Substances which have the power of preventing the growth and development of bacteria.

Antisialics: Medicines or agents which reduce the secretion of the saliva.

Antispasmodics: Medicines used for the relief of nervous irritability and minor spasms.

Antisyphilitics: Medicines used in the treatment of syphilis.

Aperient: A mild cathartic.

Aphrodisiacs: Medicines which stimulate sexual appetite and function.

Aromatics: Medicines characterized by a fragrant or spicy taste and odor and which stimulate the gastrointestinal mucous membrane.

Aromatic bitters: Medicines which unite the properties of the aromatics and the simple bitters.

Astringents: Medicines which produce shrinkage of mucous membranes or raw tissues, decreasing the amount of exudation from them.

Bitters, simple: Medicines which have a bitter taste and have the effect of stimulating the gastrointestinal mucous membrane without affecting the general system.

Cardiac depressants: Medicines used to lessen the force and frequency of the heart's action.

Cardiac stimulants: Medicines used to increase the force and frequency of the heart's action.

Carminatives: Medicines which aid in the expulsion of gas from the stomach and intestines by increasing peristalsis, stimulating circulation, etc.

Cathartics: Medicines which increase or hasten the evacuation of the intestines. They are classified according to their power, as follows: *Laxatives or aperients, simple purgatives, drastic purgatives, saline purgatives, hydrogogues, cholagogues.*

Cerebral depressants: Medicines which lower or suspend the functions of the higher brain after a preliminary stage of excitement.

Cerebral excitants: Medicines which, if given in proper doses, increase the functional activity of the cerebrum without causing any subsequent depression or suspension of the brain function.

Correctives: Medicines which are used to correct or render more pleasant the action of other remedies, especially purgatives.

Deliriant: Medicines which excite the functional activity of the higher brain to such a degree as to disorder the mental faculties and produce intellectual confusion, loss of will power, delirium, and even convulsions.

Demulcents: Substances usually of oleaginous or mucilaginous natures, which soothe and protect the parts to which they are applied.

Deodorants: Substances which destroy or hide foul odors.

Diaphoretics: Medicines which produce increased excretion of sweat.

Digestants: Ferments and acids which have the power of aiding in the solution of food.

Disinfectants: Substances which have the power of destroying disease germs.

Diuretics: Medicines which increase the secretion of the urine.

Emetics: Medicines which produce vomiting.

Escharotics or caustics: Substances which destroy the tissue to which they are applied and produce a slough.

Expectorants: Medicines which increase bronchial secretion.

Febrifuges: Medicines which lessen fever.

Hæmostatics: Medicines which arrest hæmorrhages (usually applied to internal bleeding).

Hepatic stimulants: Medicines which increase the functional activity of the liver cells and the amount of bile secreted.

Hypnotics: Medicines which, in the proper doses, produce sleep without narcotic or deliriant effects.

Irritants: Substances which, when applied to the skin, produce more or less vascular excitement. When employed to excite a reflex influence on a part remote from the place of application they are termed *counterirritants*. *Rubefacients*, the mildest of this group, cause redness (congestion) of the skin. *Vesicants* or blistering agents produce decided inflammation of the skin and the accumulation of serum between the epidermis and the derma.

Motor depressants: Medicines which lower the functional activity of the spinal cord and the motor apparatus, and in large doses paralyze them directly.

Motor excitants: Medicines which increase the functional activity of the spinal cord and motor apparatus, producing heightened reflex excitability, disturbances of motility, and when given in large doses, tetanic convulsions; their ultimate effect being motor paralysis from overstimulation.

Mydriatics: Medicines which cause dilation of the pupil.

Myotics: Medicines which cause contraction of the pupil.

Narcotics: Drugs which "lessen the relationship of the individual to the external world." At first excitant to the higher brain they soon cause profound sleep, characterized by increasing stupor, and if the dose is sufficient, coma, insensibility, and death by paralysis of the nerve centers which control organic life.

Neurotics: Medicines which act upon the nervous system.

Nutrients: Medicines which modify the nutritive processes.

Nutrients: Substances which give nourishment to the system.

Parasiticides: Medicines which destroy the various animal and vegetable parasites.

Prophylactics: Medicines which prevent the taking or the development of disease.

Pulmonary sedatives: Medicines which relieve cough and dyspnoea by lessening the irritability of either the respiratory center or the nerves of respiration.

Purgatives: Medicines which produce free evacuation of the bowels.

Refrigerants: Medicines which impart a sensation of coldness and thereby allay thirst and restlessness.

Renal depressants: Medicines or agents which lessen the secretion of the urine.

Respiratory depressants: Medicines which lower the action of the respiratory center.

Respiratory stimulants: Medicines which exalt the function of the respiratory center in the medulla, quickening and deepening the breathing.

Sialogogues: Medicines which increase the secretion of the salivary glands (the secretion of the mouth).

Soporifics: Hypnotics.

Specifics: Medicines which have a direct curative influence on certain individual diseases.

Stomachics or gastric tonics: Medicines which increase the appetite and promote gastric digestion.

Styptics: Medicines or applications to control external hæmorrhages.

Taniacides: Medicines which kill the tapeworm.

Tonics: Medicines which augment gradually and permanently the strength and vital activity of the body or its organs, increasing the vigor of the entire system.

Vermicides: Medicines which kill intestinal worms.

Vermifuges: Medicines which cause the expulsion of intestinal worms.

Vesical sedatives: Medicines which lessen the irritability of the bladder, decreasing the desire to urinate, and relieving vesical pain and tenesmus.

Vesical tonics: Medicines which increase the tone of the muscular fibers in the wall of the bladder, consequently the power for contracting and expelling the urine is increased.

Administration of medicines.

The normal or adult dose of medicine is based upon the condition that the individual must be 24 years of age and weigh about 150 pounds. Persons under 24 and over 60 years of age require smaller doses in proportion.

In computing the dose for persons under 24 years of age, the following rules are applicable. *Young's rule* directs that the age of the person be taken as the numerator of the fraction and the age plus 12 as the denominator. Thus for a child 3 years old 3 would be the numerator and 3 plus 12, or 15, the denominator, $\frac{3}{3+12}=1/5$ of adult dose. *Cowling's rule* directs that the age at next birthday be taken as the numerator of the fraction, and 24 (the age of the adult) as the denominator of the fraction.

In using either of the above rules it should be remembered that children usually require larger doses of purgatives, diaphoretics, and diuretics, and smaller doses of narcotics than is called for.

When the dose of a drug is spoken of, the amount necessary to produce a medicinal effect in an adult, or the *therapeutic dose*, ordinarily is meant. The doses given in the Pharmacopœia are the average therapeutic doses. In addition, there are the *minimum dose*, the smallest quantity which can produce a medicinal effect, the *maximum dose*, the largest quantity which can be given without probable poisoning or harmful effects, the *toxic dose*, which is the amount producing poisoning, and the *lethal dose*, which is the smallest dose that will produce death. The average dose is the one usually learned. In the administration of medicines there are many factors which affect the dose, the method of administration, and the frequency of the doses. These conditions, briefly described, are:

1. *Age.*—Children (see above rules) and aged adults as a rule require less than the normal adult dose.

2. *Sex.*—Females require smaller doses than males.

3. *Race.*—Negroes usually require larger and Asiatics smaller doses than white people.

4. *Physical condition.*—Strong, burly patients require larger doses than weak patients.

5. *Temperament.*—Sanguine (ardent, cheerful, full-blooded) temperaments require smaller doses of stimulants than phlegmatic (heavy, dull, stolid, apathetic) temperaments.

6. *Idiosyncrasy.*—This is the peculiarity of individuals to tolerate certain drugs.

7. *Climate.*—People in warm climates, as a rule, require smaller doses of purgatives.

8. *Occupation.*—Men working out of doors at hard labor will require larger doses than those who sit at a desk all day.

9. *Habitual use.*—This modifies the dose by lessening the medicinal power of the drug, and the dose must be increased greatly to obtain a medicinal effect (opium, morphine, and cocaine users).

10. *Disease.*—Disease conditions modify the dose, as in tetanus and peritonitis, when larger doses of narcotics are tolerated.

11. *Form of the drug.*—This controls largely the rate of absorption, as all substances must be reduced to solution before entering the circulation.

12. *Time of administration.*—Drugs given before a meal are more quickly absorbed than those administered upon a full stomach.

13. *Mode of administration.*—As a rule drugs administered hypodermically are used in much smaller quantities.

14. *The frequency of administration.*—It is obvious that the dose of a drug is less if administered frequently than if administered at long intervals.

Medicinal substances may be introduced into the circulation by any one of the following methods:

By mouth.—This is the most common of all methods and is usually the most desirable except when very rapid action is required.

Subcutaneously.—This method frequently is used when rapid action is desired or when the stomach will destroy the virtue of the drug if given by mouth.

By rectum.—This method is used when it is impossible to administer drugs by mouth because of vomiting, semi or unconsciousness, delirium, or certain disease of the gastrointestinal tract.

By inunction.—This consists of applying ointments or oily combinations to the skin and rubbing them in.

Intravascularly.—By this means preparations of drugs are introduced directly into a vein.

Inhalation.—By this method medicated vapors or drugs, such as ether or chloroform, are inhaled into the respiratory system.

Fumigation.—In this manner easily volatilized drugs are applied directly to the skin, except the head, by means of a vapor bath.

By hypodermoclysis.—This consists of introducing solutions of saline into the loose tissues about the breasts, abdomen, or below the scapulæ.

Intramuscularly.—This consists of injecting readily absorbable, sterile preparations of drugs into the muscle tissue.

In order to obtain the greatest benefit of their action, as a general rule, *bitters* are administered before meals; *alkalies*, if to increase the flow of gastric juice, before meals; if to neutralize the acidity of the gastric juice, after meals; *acids*, one-half to one hour before meals; *laxatives*, before retiring; *active cathartics*, the first thing in the morning; *hypnotics*, from one-half to two hours before sleep is required; *slowly acting drugs* (*digitalis*), at long intervals; *rapidly acting drugs* (*ammonia*, *nitroglycerine*) at very short intervals; such drugs as *mercury*, *arsenic*, *iron*, *iodides*, not on an empty stomach, but from one-half to one hour after meals.

Following is a brief description of drugs in common use, grouped in the various classes to which they belong. In addition to the medicines listed on the Supply Table of the Medical Department, United States Navy, several important drugs used, more or less, in the treatment of disease also are given.

INORGANIC MATERIA MEDICA.

The official Latin and English titles, the common names or synonyms, and the symbolic formulas, if any, appear in italics in the following descriptions of medicinal substances. Those official in the Pharmacopœia are indicated by the letters U. S. P. following the names, and drugs recognized by the National Formulary by the letters N. F.

The nonmetals and some of their compounds.

The Halogens.—The halogen elements are *fluorine*, *chlorine*, *bromine*, and *iodine*. Owing to the readiness with which they combine with metals to form

salts which are much alike and resemble common salt in their properties, the name halogen (meaning salt producer) has been applied to this group of elements. In their chemical and physical properties the halogen elements are closely related. They are classed as negative elements because they are electro-negative in their properties, combining with electropositive elements (metals) to form stable compounds (salts).

Chlorum, Chlorine, Cl.—Chlorine is not recognized by the Pharmacopœia, but a number of compounds containing chlorine in loose chemical union from which it can be set free easily are official, and one of these is on the Supply Table, chlorinated lime.

Chlorine is a yellowish green gas, having a suffocating odor, and when inhaled acts as a corrosive poison to the mucous membrane of the air passages. It is a deadly poison and was used during the World War as a poisonous gas. It is chemically very active, and this property is taken advantage of in the use of chlorine as a disinfectant and bleaching agent.

Calc Chlorinata, Chlorinated Lime (Chloride of Lime), U. S. P.—A product resulting from the action of chlorine upon calcium hydroxide and containing not less than 30 per cent of available chlorine. Preserve it in air-tight containers, in a cool and dry place.

PROPERTIES: It occurs as a white or grayish white granular powder having the odor of chlorine. It becomes moist and gradually decomposes on exposure to the air. When in that condition this substance must not be used or dispensed. When treated with an acid, chlorine is liberated freely. It has been proved by experiment that chlorinated lime at 98° F. loses 96 per cent of its efficiency measured as "available chlorine," in eight weeks, and at a higher temperature the loss is greater. The decomposition is evidently largely due to the moisture in the bleaching powder, as dry powder keeps better than the moist. This rapid loss of chlorine can be overcome to a great extent by mixing quicklime (CaO) with the chlorinated lime in the proportion of three parts of quicklime to seven parts of chlorinated lime. This is sufficient to absorb the moisture and keep the chlorinated lime dry.

ACTION AND USES: It is used in the preparation of chlorinated soda, U. S. P., and chlorated potassa, N. F. Extensively used as a bleaching agent. Its principle use in medicine is as a disinfectant and deodorant. In the field with troops it is used as a disinfectant for excreta and for the disinfection of water; 1 gram is sufficient to purify 40 gallons of water.

Chlorazene (Chloramine-T), Sodium Para-toluene-sulpho-chloramide $\text{CH}_3\text{C}_6\text{H}_4\text{SO}_2\text{NaCl} + 3\text{H}_2\text{O}$.—It is an active germicide acting like the hypochlorites, but less irritating. It does not coagulate or precipitate proteins, and is non-toxic and noncaustic.

USES: It is used in the treatment of infected wounds where a nonirritating germicide is desired in aqueous solution from 0.1 to 4 per cent.

Dichloramine-T, Para-toluene-sulpho-dichloramide, $\text{CH}_3\text{C}_6\text{H}_4\text{SO}_2\text{NCl}_2$.—It contains about 29.5 per cent of available chlorine.

PROPERTIES: It is a pale yellowish, crystalline powder, having a strong chlorous odor; is insoluble in water, but soluble in chloroform, a chlorinated and liquified paraffin wax manufactured especially as a solvent for dichloramine-T.

ACTION AND USES: Solutions of dichloramine-T made with chloroform in strengths from 1 to 5 per cent are employed in surgery as an antiseptic. Weaker solutions are employed for the treatment of nose and throat affections. The solutions should be kept in glass-stoppered, amber bottles, and protected from high temperature and direct sunlight.

Iodum, Iodine, I., U. S. P.—It contains not less than 99.5 per cent of I. Preserve it in glass-stoppered bottles, in a cool place.

PROPERTIES: It occurs as heavy, bluish-black, brittle, rhombic plates, having a metallic luster, a distinctive odor, and a sharp, acid taste. Specific gravity, 4.66. It is soluble in 2,950 parts of water, 12.5 c. c. of alcohol, 80 c. c. of glycerin, and is freely soluble in chloroform, ether, or aqueous solutions of iodides (potassium iodide). With starch paste it gives a deep-blue color. The color of iodine is discharged by sodium hyposulphite (used to remove iodine stains).

PREPARATION: It is obtained from Chilean saltpeter, where it occurs as sodium iodate mixed with sodium nitrate, but is obtained chiefly from the ashes of certain seaweed known as kelp (sodium iodide).

ACTION AND USES: See tincture of iodine. It is used in making tincture of iodine, U. S. P., compound solution of iodine, U. S. P., and iodine ointment, U. S. P.

Average dose: 0.005 gm., or one-twelfth grain.

Tinctura Iodi, Tincture of Iodine, U. S. P.—An alcoholic solution of iodine and potassium iodide. One hundred c. c. contains not less than 6.5 gm. nor more than 7.5 gm. of I., and not less than 4.5 gm. nor more than 5.5 gm. of KI.

PREPARATION: See U. S. P.

ACTION AND USES: It is applied externally as a counterirritant, disinfectant, and parasiticide. It may be applied to any part of the body externally except the eye. An alcoholic solution (half strength) containing equal parts of the tincture and alcohol is employed in the disinfection of the skin before operations. It penetrates into the pores and acts as a powerful germicide. It should never be painted over a surface that previously has been washed with bichloride of mercury solution, because in the presence of the bichloride new compounds are formed which are intensely irritating, especially under a dressing, and blistering of the skin is liable to occur. To get the best germicidal results from tincture of iodine, it should not be applied to a surface wet with water. Internally tincture of iodine is used as an alterative. It acts as an irritating poison in large doses. *The antidote is starch paste or starchy foods.* Iodine stains can be removed from linen with a solution of sodium hyposulphite.

Average dose: 0.1 c. c. or $1\frac{1}{2}$ minims (diluted with water).

Oxygen, nitrogen, and sulphur.

Oxygenum, Oxygen, O., U. S. P.—It contains not less than 95 per cent by volume of O. For convenience it usually is compressed in metal cylinders.

PROPERTIES: It is a colorless, odorless, tasteless gas, and supports combustion more readily than air. It is soluble in 34 volumes of water and in 3.6 volumes of alcohol.

PREPARATION: Oxygen is prepared extemporaneously by the action of water on sodium peroxide. The action is made to take place in a suitable metallic container and the oxygen is generated and liberated when it is needed. Oxygen freshly made is more efficient than that stored in cylinders. Lungmotors and pulmotors are supplied with sodium peroxide generators for making oxygen. The reaction that takes place is $\text{Na}_2\text{O}_2 + \text{H}_2\text{O} = 2\text{NaOH} + \text{O}$.

ACTION AND USES: It is administered by inhalation whenever the amount of oxygen that the patient is able to take from the air is insufficient, as in cardiac diseases, pulmonary oedema, pneumonia, asphyxia from toxic gases, drowning, etc. It forms a definite compound with the hæmoglobin of the blood, giving the blood its bright-red color. It frequently is used with nitrous oxide in anæsthesia to prevent cyanosis.

Aqua, Water, H₂O., U. S. P. (ordinary drinking water).—Water is a colorless, limpid liquid practically tasteless and odorless. It is neutral to litmus. (See U. S. P. for standard of purity.) Ordinary water very often contains, in solution or suspension, traces of salts, organic matter, and gases. These impurities do not render it unfit for drinking purposes or for making many pharmaceutical preparations for immediate use, but their presence is a serious objection in certain cases in which water is used as a solvent.

Aqua Destillata, Distilled Water, U. S. P.—The Pharmacopœia requires that distilled water be practically free from all other matter, and that it be composed entirely of H₂O. When water is directed to be used in the formulas of the U. S. Pharmacopœia and the National Formulary, distilled water nearly always is specified. Distilled water should be kept in glass-stoppered bottles which have been rinsed with hot distilled water before being filled.

Aqua Destillata Sterilizata, Sterilized Distilled Water, U. S. P.—It is made by sterilizing freshly distilled water in a flask made of hard glass (which previously has been cleaned and sterilized as directed by the Pharmacopœia), into the mouth of which has been introduced a pledget of sterilized purified cotton. Sterilization is accomplished by boiling the water for 30 minutes and allowing it to cool without removing the cotton. After it cools the mouth of the flask is tightly covered with a piece of paper to prevent contamination through the air. Sterilized distilled water is used largely in making solutions for intravenous injections, and to insure against infection it should be used within 48 hours after it is made. As an added precaution it is well to use double-distilled water in making up sterilized distilled water.

Liquor Hydrogenii Dioxidii, Solution of Hydrogen Dioxide, H₂O₂ (*Solution of Hydrogen Peroxide, Aqua Hydrogenii Dioxidii*), U. S. P.—An aqueous solution containing not less than 3 per cent by weight of H₂O₂ (34.02), corresponding to not less than 10 volumes of available oxygen. Preserve it in a cool place protected from light. Only slight pressure should be used in removing the stopper from the bottle.

PREPARATION: It is made by the action of barium dioxide on phosphoric acid, $\text{BaO}_2 + \text{H}_3\text{PO}_4 = \text{Ba}(\text{HPO}_4) + \text{H}_2\text{O}_2$.

PROPERTIES: Hydrogen dioxide is decomposed easily into water and oxygen and its bleaching and antiseptic properties are due to the oxygen which it gives up. This decomposition takes place rapidly in the presence of decomposing organic matter. In contact with pus it gives off oxygen so rapidly that effervescence is produced.

USES AND DOSAGE: It is of great value in cleaning wounds and ulcers. It should not be injected into cavities unless there is a free outlet for the escaping oxygen. It is used extensively as a mouth wash and gargle. Its antiseptic properties are of short duration because its energy quickly is spent. It rarely is given internally.

Average dose: 4 c. c. or 1 fluid dram.

Nitrogenii Monoxidum, Nitrogen Monoxide, N₂O (*Nitrous Oxide, Laughing Gas*), U. S. P.—It is nitrogen monoxide gas (N₂O).

PROPERTIES: It is a colorless gas, having a slight characteristic odor and a sweetish taste. It is very soluble in water at low temperature, and supports the combustion of many substances.

ACTION AND USES: It is a general anæsthetic and is used both in surgery and in dentistry. It also is used in conjunction with ether for anæsthesia purposes, producing anæsthesia in from one to three minutes. It usually is given mixed with oxygen to avoid narcosis.

Sulphur sublimation, Sublimed Sulphur, S, (Flowers of Sulphur), U. S. P.—It contains, when dried to constant weight over sulphuric acid, not less than 99.5 per cent of S.

PROPERTIES: It is a fine, yellow powder, having a slight characteristic odor and faintly acid taste. It is insoluble in water, nearly insoluble in alcohol, slightly soluble in ether, and partly soluble in chloroform, carbon disulphide, and olive oil.

PREPARATION: Sulphur is obtained in the United States principally from sulphur mines located in Louisiana, Texas, Utah, California, and Nevada, where it exists in the free state (uncombined chemically). In Louisiana and Texas it is mined by forcing steam under high pressure between the walls of a double-walled iron pipe into the deposits, thus melting the sulphur, and the pressure of the steam forces the molten sulphur out through the inner pipe. It then is washed and purified by sublimation (sublimed sulphur). Sulphur nearly always is contaminated with arsenic and before it is fit for internal use it must be treated with dilute ammonia water, which not only removes arsenic but also the acids of sulphur, after which it is known as washed sulphur. Washed sulphur is used internally and sublimed sulphur externally.

ACTION AND USES: Internally, sulphur (washed) is used as a laxative. Compound licorice powder which is used as a laxative contains washed sulphur. Externally, sulphur (sublimed) is used as a parasiticide, in the form of the ointment (U. S. P.). Sulphur ointment is an efficient remedy in the treatment of scabies. Sulphur dioxide gas is generated by burning sulphur in the air (oxygen). Five pounds of sulphur will generate sufficient sulphur dioxide to disinfect 1,000 cubic feet of air space.

Average dose: 4 gm. or 1 dram (washed sulphur).

Inorganic or mineral acids.

These compounds all contain hydrogen which is replaceable by metals forming salts, have a characteristic sour taste and corrosive action, and change the color of blue litmus to red. When acted upon by a base (alkali) they are neutralized and in turn neutralize the base, forming a salt and water. This is why an acid is used as an antidote for poisoning by a base, and a base as the antidote for acid poisoning. *An acid is defined as a compound of hydrogen with an electronegative element or radicle.* Sulphur (S) is an electronegative element and when it is combined with hydrogen we have H_2S , hydrosulphuric acid; SO_4 is the electronegative sulphate radicle, and when it is combined with hydrogen we have H_2SO_4 , sulphuric acid. The strong inorganic acids should be handled with great care because they are very corrosive and poisonous. When given internally they should be very highly diluted, and should be taken through a glass tube to prevent injury to the teeth, and followed by rinsing the mouth with a solution of sodium bicarbonate. *The chemical antidote for acid poisoning is any mild alkali; as, lime water, milk of magnesia, chalk, bicarbonate of soda, etc.*

Acidum Hydrochloricum, Hydrochloric Acid, HCl. (Muriatic Acid), U. S. P.—An aqueous solution containing not less than 31 per cent nor more than 33 per cent of HCl. Preserve it in glass-stoppered bottles. It should be noted that about 68 per cent of the liquid is water and only 32 per cent (by weight) is hydrochloric acid (gas). Absolute HCl is a gas and this preparation is a solution of HCl gas in water.

PREPARATION: It is made by acting on sodium chloride (common salt) with sulphuric acid. $2\text{NaCl} + \text{H}_2\text{SO}_4 = 2\text{HCl}$.

PROPERTIES: It is a colorless, fuming liquid having a pungent odor and an intensely acid taste. The fumes and odor disappear on adding the acid to twice its volume of water. It is strongly acid to litmus. Salts of hydrochloric acid are known as chlorides (sodium chloride) or as muriates (NH_4Cl , ammonium muriate). An aqueous solution containing not less than 9.5 per cent nor more than 10.5 per cent HCl is known as dilute hydrochloric acid.

ACTION AND USES: Hydrochloric acid is a normal constituent of the gastric juice and sometimes is administered to make up any deficiency of this substance in the gastric juice. Its principal use is in the manufacture of chlorides (salts), many of which are used in medicines. It also is used with nitric acid in making nitrohydrochloric acid.

Average dose: 1 c. c. or 15 minims of the dilute acid. It should be diluted with one fluidounce of water and taken through a glass tube.

Acidum Nitricum, Nitric Acid, HNO_3 (Aqua Fortis), U. S. P.—An aqueous solution containing not less than 67 per cent nor more than 69 per cent of HNO_3 . Preserve it in dark amber colored, glass-stoppered bottles, and protect it from light.

PROPERTIES: Nitric acid is a colorless, fuming liquid, very caustic and corrosive, and has a peculiar, somewhat suffocating odor. It should be handled with extreme care.

PREPARATION: Made by the action of sulphuric acid on sodium nitrate. $\text{NaNO}_3 + \text{H}_2\text{SO}_4 = \text{NaHSO}_4 + \text{HNO}_3$.

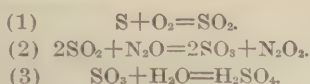
ACTION AND USES: Nitric acid rarely is given internally. It is used in the manufacture of salts of nitric acid (nitrates) and in the manufacture of explosives (trinitro-phenol, glyceryl trinitrate, trinitro-toluol, etc.) It is an extensively used oxidizing agent, breaking down in the presence of oxidizable substances, as follows: $2\text{HNO}_3 = \text{H}_2\text{O} + \text{N}_2\text{O}_5 + 3\text{O}$. Applied to tissues it acts as an energetic caustic and frequently is used for cauterization and to remove warts. It is used with hydrochloric acid in the preparation of nitrohydrochloric acid (not given internally).

Acidum Sulphuricum, Sulphuric acid, H_2SO_4 (Oil of Vitriol), U. S. P.—A liquid containing not less than 93 per cent nor more than 95 per cent of H_2SO_4 . Preserve it in glass-stoppered bottles.

PROPERTIES: A colorless, odorless liquid, of oily consistency, very caustic and corrosive; strongly acid to litmus even when highly diluted. Specific gravity about 1.83 at 25°C . Miscible with water or alcohol, with the evolution of much heat; *the acid must be added with great caution to the diluent. In mixing water and sulphuric acid the acid always should be added to the water, and not the water to the acid.* When mixed in a glass vessel the acid should be added slowly to avoid a sudden increase of temperature with possibility of breaking the glass vessel. Because of its great affinity for water it is used as a desiccating agent. Being one of the strongest acids known, it is capable of decomposing salts of other acids, forming salts of sulphuric acid, and setting free the other acids. This principle already has been demonstrated in the making of hydrochloric and nitric acids. (The chemical principle here displayed is that *whenever a stronger acid acts on a salt of a weaker acid, a salt of the former is formed, and the weaker acid is set free.*)

PREPARATION: There are several methods now employed in the manufacture of sulphuric acid, the principles involved being practically the same. Sulphur is burned with the oxygen of the air forming sulphur dioxide; the sulphur dioxide is oxidized by the action of either an oxidizing agent (nitric acid) or a catalytic agent (platinum sponge) to sulphur trioxide. The sulphur trioxide then is brought in contact with steam in a leaden chamber (sulphuric acid does

not act on lead), forming sulphuric acid. The simplest expression of the reactions involved is as follows:



Dilute sulphuric acid is an aqueous solution containing not less than 9.5 per cent nor more than 10.5 per cent of H_2SO_4 .

Average dose of the dilute acid is 1 c. c. or 15 minims.

ACTION AND USES: Sulphuric acid rarely is given internally. Its principal use is in manufacturing other preparations. Not only is it used in the preparation of salts (sulphates) of sulphuric acid, but also in the manufacture of acids from their salts.

Acidum Sulphuric Aromaticum, Aromatic Sulphuric Acid (Elixir of Vitriol) U. S. P.—Aromatic sulphuric acid contains free sulphuric acid and ethyl sulphuric acid ($\text{C}_2\text{H}_5\text{HSO}_4$), together equivalent to not less than 19 per cent nor more than 21 per cent of H_2SO_4 . Preserve it in glass stoppered bottles.

PROPERTIES: It is a clear, reddish-brown liquid, having a pleasant aromatic odor and is strongly acid to litmus.

PREPARATION: It is made by mixing sulphuric acid, ethyl alcohol, and aromatics.

ACTION AND USES: Used for night sweats in tuberculosis cases.

Average dose: 1 c. c. or 15 minims.

Acidum Boricum, Boric Acid, H_3BO_3 (Boracic Acid), U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99.5 per cent of H_3BO_3 .

PROPERTIES: Boric acid occurs in transparent, colorless scales, of a somewhat pearly luster, or as a white bulky powder; slightly unctuous to the touch, odorless, having a faintly bitter taste and is permanent in the air. One gram of boric acid dissolves in 18 c. c. of water, 18 c. c. of alcohol, and in 4 c. c. of glycerin, at 25°C . It is much more soluble in hot water or hot alcohol. Boric acid volatilizes from a boiling aqueous or alcoholic solution. It is faintly acid to litmus, being one of the weakest known acids.

PREPARATION: It is made from sodium borate (borax) which is found in the United States in dried-out lakes in California. Sodium borate is treated with hydrochloric acid setting free the boric acid. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O} + 2\text{HCl} = 2\text{NaCl} + 4\text{H}_3\text{BO}_3 + 5\text{H}_2\text{O}$.

ACTION AND USES: It is used most extensively as a mild antiseptic. Its concentrated aqueous solution (5 per cent) can be used in any of the body cavities or orifices. It is used as an antiseptic dressing in surgery. Boric acid solution is used as an eye wash. It also may be used in the form of an ointment or as a dusting powder. It has been used as a food preservative but its use for this purpose is being restricted by the State and national food and drug acts.

Average dose: 0.5 gm. or 8 grains (rarely used internally).

The alkali elements and their compounds.

The alkali metals are *potassium, sodium, lithium, and the radicle ammonium*. Chemically they are strongly electropositive, being directly opposite to the halogens. They are monovalent, soft, waxlike in consistence, having a low melting point, readily oxidize in the air and decompose water forming strong hydroxides (alkalies). These strong alkalies are very caustic and poisonous. Nearly all the salts of these alkalies (formed by their union with acids) are soluble in

water. Potassium, sodium, and lithium as such have no special medicinal action of value. The medicinal properties of their chemical compounds are exerted by the acid radicles with which they are combined; therefore the medicinal properties of the alkali salts vary greatly. *The chemical antidote for the strong alkalis is any weak acid, as citric acid, vinegar, dilute acetic acid, etc.* When acids and alkalis are brought together in solution they neutralize each other forming new compounds (salts). In this way they act as antidotes for each other.

Potassii Hydroxidum, Potassium Hydroxide, KOH (Caustic Potash, Lye, Potassium Hydrate), U. S. P.—It contains not less than 85 per cent of KOH. Preserve it in well closed containers. If bottles are used they must be made of hard glass.

PROPERTIES: Potassium hydroxide occurs in dry, white, or nearly white flakes, fused masses, or sticks; is hard and brittle and odorless. Great caution is necessary in handling it, as it rapidly destroys organic tissue. When exposed to the air it rapidly absorbs carbon dioxide and moisture, and deliquesces. It is very soluble in water, alcohol, and glycerin. (All the salts of potassium are soluble in water except potassium bitartrate.) It is strongly alkaline to red litmus, turning it blue even in a very dilute solution.

PREPARATION: It is made by electrolysis (passing an electric current through potassium chloride).

ACTION AND USES: Pure potassium hydroxide is not given internally, but a 5 per cent solution sometimes is administered (dose 1 c. c.) as an antacid. *If a large quantity should be swallowed accidentally, give vinegar or lemon juice as the antidote.* Potassium hydroxide is used in making soap (soft soap). Lye may be composed of potassium hydroxide, although it usually contains sodium hydroxide, a cheaper substance. It sometimes is used as a caustic, but its principal use in medicine is in the manufacture of potassium salts.

Potassii Acetas, Potassium Acetate, KC₂H₃O₂, U. S. P.—It contains, when dried to constant weight at 150° C., not less than 99 per cent of KC₂H₃O₂. Preserve it in air-tight containers.

PROPERTIES: It is very deliquescent on exposure to the air, and is very soluble in both water and alcohol. An aqueous solution is alkaline to litmus.

PREPARATION: It is made by the action of acetic acid on potassium bicarbonate. $\text{KHCO}_3 + \text{CH}_3\text{COOH} = \text{CH}_3\text{COOK} + \text{CO}_2 + \text{H}_2\text{O}$.

ACTION AND USES: Used as a diuretic, diaphoretic, and to render the urine alkaline. In large doses it acts as a laxative. It is decomposed in the system, forming carbonates.

Average dose: 1 gm. or 15 grains.

Potassii Bicarbonas, Potassium Bicarbonate, KHCO₃, U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99 per cent of KHCO₃. Preserve it in well closed containers.

PROPERTIES: It is very deliquescent on exposure to air. It is very soluble in water, but almost insoluble in alcohol. When a solution of potassium bicarbonate is heated it is converted into potassium carbonate. An aqueous solution is slightly alkaline to litmus.

PREPARATION: It is made by passing carbon dioxide into a solution of potassium carbonate until it is saturated. $\text{K}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O} = 2 \text{KHCO}_3$.

ACTION AND USES: Its action when given internally is very much like that of potassium acetate. It renders the blood and urine alkaline. In manufacturing pharmacy it is used in the preparation of many of the other potassium salts.

Average dose: 1 gm. or 15 grains.

Potassii Bitartras, Potassium Bitartrate, $\text{KHC}_4\text{H}_4\text{O}_6$ (Cream of Tartar), U. S. P.—It contains, when dried to constant weight at 100°C ., no less than 99.5 per cent of $\text{KHC}_4\text{H}_4\text{O}_6$. Preserve it in well-closed containers.

PROPERTIES: Occurs as a colorless or slightly opaque, gritty powder, odorless, and having a pleasant acidulous taste. It is very slightly soluble in water (the only sparingly soluble potassium salt in common use) and insoluble in alcohol. A saturated solution is acid to litmus.

PREPARATION: It is made by purifying tartar, a substance deposited in wine casks during fermentation of grape juice in making grape wines.

ACTION AND USES: Occasionally given as a hydrogogue cathartic. It is one of the constituents of baking powders. In baking powder it acts slowly on bicarbonate of sodium, liberating carbon dioxide, which becomes entangled in the dough and causes it to rise. It sometimes is used as a diuretic.

Average dose: 2 gm. or 30 grains.

Potassii Bromidum, Potassium Bromide, KBr , U. S. P.—It contains, when dried to constant weight at 100°C ., not less than 98.5 per cent of KBr . Preserve it in well-closed containers.

PROPERTIES: Occurs as colorless or white cubical crystals or granular powder, odorless, and having a strongly alkaline taste. It is very soluble in water and glycerin and slightly soluble in alcohol. Its aqueous solution is faintly alkaline to litmus.

PREPARATION.—It is made by passing bromine into a hot solution of potassium hydroxide when the following reaction takes place: $6\text{KOH} + 3\text{Br}_2 = 5\text{KBr} + \text{KBrO}_3 + 3\text{H}_2\text{O}$. The solution is evaporated to dryness and the residue is heated with charcoal (carbon) to redness when the bromate formed in the above reaction is reduced by the carbon to bromide, as follows: $2\text{KBrO}_3 + 3\text{C} = 2\text{KBr} + 6\text{CO}$. Potassium iodide and sodium bromide are made by an analogous process.

ACTION AND USES: Used as a nerve sedative and hypnotic.

Average dose: 1 gm. or 15 grains.

Potassii Chloras, Potassium Chlorate, KClO_3 , U. S. P.—It contains not less than 99 per cent of KClO_3 . Preserve it in well-closed containers. Great caution should be observed in handling it, as dangerous explosions are liable to occur when it is heated or subjected to concussion or trituration with organic substances (cork, tannin, dust, sugar, etc.) or with sulphur, sulphides, hypsulphites, or other easily oxidizable substances.

PROPERTIES: It occurs as colorless crystals or a white granular powder, odorless, and having a peculiar cooling taste. It is soluble in 11.5 parts of water, soluble in glycerin, and insoluble in alcohol. It is capable of yielding oxygen when heated.

PREPARATION: It is made by boiling together a solution of potassium chloride and calcium hypochlorite.

ACTION AND USES: Applied locally in aqueous solution it acts as an antiseptic and stimulant to mucous membranes. It is decomposed easily by septic matter, yielding nascent oxygen, to which it owes its antiseptic properties. It is used in the following inflammatory conditions of mucous membranes: Catarrhal inflammations of the mouth and fauces, ulcerative and mercurial stomatitis, nursing sore mouth, and tonsillitis. When given internally in large doses it is liable to cause destruction of the red blood cells.

Average dose: 0.25 gm. or 4 grains (rarely used internally).

Potassii et Sodii Tartras, Potassium and Sodium Tartrate (Rochelle Salt), U. S. P.—It contains not less than 73.73 per cent nor more than 77.39 per cent of anhydrous potassium and sodium tartrate, corresponding to not less than 99

per cent of the crystallized salt ($\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$). Preserve it in well-closed containers.

PROPERTIES: Occurs as colorless, transparent crystals or white granular powder, odorless, and having a saline taste. Very soluble in water and almost insoluble in alcohol and slightly efflorescent in dry air. Its aqueous solution is slightly alkaline to litmus.

PREPARATION: Made by neutralizing potassium bitartrate with sodium carbonate. $2\text{C}_2\text{H}_2(\text{OH})_2\text{COOK} \cdot \text{COOH} + \text{Na}_2\text{CO}_3 = 2\text{C}_2\text{H}_2(\text{OH})_2\text{COOK} \cdot \text{COONa} + \text{H}_2\text{O} + \text{CO}_2$.

ACTION AND USES: Rochelle salt is an extensively used purgative in the form of Seidlitz Powder, U. S. P. (A seidlitz powder consists of two powders, one wrapped in white paper, and the other wrapped in blue paper. The contents of the blue paper are: Rochelle salt (115 grains), and sodium bicarbonate (38 grains). The white paper contains 33 grains of tartaric acid. When administered the contents of the two powders are dissolved separately, each in a half a glass of water, and then they are poured together and taken while effervescing. The effectiveness is caused by the action of the tartaric acid on the bicarbonate of sodium as follows: $\text{C}_2\text{H}_2(\text{OH})_2(\text{COOH})_2 + \text{NaHCO}_3 = \text{C}_2\text{H}_2(\text{OH})_2\text{COONa} \cdot \text{COOH} + \text{CO}_2 + \text{H}_2\text{O}$. In this reaction sodium bitartrate is formed.

Average dose: 1 set of two powders; 10 gm. or $2\frac{1}{2}$ drams.

Potassii Citras, Potassium Citrate, U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99 per cent of $\text{C}_3\text{H}_4(\text{OH}) \cdot (\text{COOK})_3 + \text{H}_2\text{O}$. Preserve it in well closed containers.

PROPERTIES: Occurs as transparent prismatic crystals or a granular powder, odorless, and having a cooling taste. It is very soluble in water and glycerin, and almost insoluble in alcohol. An aqueous solution is alkaline to litmus. It is deliquescent when exposed to moist air; therefore it should be kept in well closed containers.

PREPARATION: It can be made by adding bicarbonate of potassium to a solution of citric acid until effervescence ceases. $\text{C}_3\text{H}_4(\text{OH}) \cdot (\text{COOH})_2 + 3\text{KHCO}_3 = \text{C}_3\text{H}_4(\text{OH}) \cdot (\text{COOK})_3 + 3\text{H}_2\text{O} + 3\text{CO}_2$.

ACTION AND USES: It is used as a diuretic and to render the urine alkaline. Its medicinal properties are very much like those of potassium acetate. Potassium citrate is not found on the supply table but it can be made, if necessary, as directed above.

Average dose: 1 gm. or 15 grains.

Potassii Iodum, Potassium Iodide, KI, U. S. P.—It contains, when dried to constant weight at 100°C ., not less than 99 per cent of KI. Preserve it in well closed containers.

PROPERTIES: It is very soluble in water and glycerin; slightly soluble in alcohol. Slightly deliquescent in moist air. Its aqueous solution is slightly alkaline to litmus.

PREPARATION: It is made by the action of iodine on an aqueous solution of potassium hydroxide. (1.) $6\text{KOH} + 3\text{I}_2 = 5\text{KI} + \text{KIO}_3 + 3\text{H}_2\text{O}$. (2.) $2\text{KIO}_3 + 3\text{C}_2 = 2\text{KI} + 6\text{CO}$.

ACTION AND USES: A valuable and much used alterative. It is used in the treatment of syphilis and rheumatism. It also is used for chronic lead, mercury, and arsenic poisoning, forming with these metals double soluble salts which are eliminated easily.

Average dose: 0.3 gm. or 5 grains.

Potassii Permanganas, Potassium Permanganate, KMnO_4 , U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not

less than 99 per cent of KMnO_4 . Preserve it in glass-stoppered bottles. Potassium permanganate when in solution or in the dry condition must not be brought into contact with organic or other readily oxidizable substances.

PROPERTIES: It occurs as slender prisms, of a dark purple color, odorless and having a disagreeable astringent taste. It is permanent in the air. It is soluble in 13.5 parts of water. *An alcoholic solution can not be made because it is decomposed by alcohol.* It is a powerful oxidizing agent, two molecules in acid solution yielding five atoms of oxygen. When it comes in contact with organic matter it is decomposed with the liberation of oxygen. This property makes it a valuable antiseptic and disinfectant.

PREPARATION: It is made by fusing together a mixture of potassium hydroxide, manganese dioxide, and potassium chlorate, forming potassium manganate. When potassium manganate is boiled with water, potassium permanganate is formed. (1.) $3\text{MnO}_2 + 6\text{KOH} + \text{KClO}_3 = 3\text{K}_2\text{MnO}_4 + \text{KCl} + 3\text{H}_2\text{O}$. (2.) $3\text{K}_2\text{MnO}_4 + 2\text{H}_2\text{O} = 2\text{KMnO}_4 + \text{MnO}_2 + 4\text{KOH}$.

ACTION AND USES: It is used as an antiseptic irrigating fluid, especially for the urethra and bladder, in strengths of from 1-4,000 to 1-10,000. It seldom is used externally, largely on account of the objectionable stain which it leaves. It is used in the treatment of poisoning by venomous snakes by injection into the wound. It also is used in the treatment of morphine poisoning. It has been used with formaldehyde solution to volatilize formaldehyde gas in disinfection of rooms, but it has been displaced for this purpose by barium dioxide, a cheaper substance.

Average dose: 0.06 gm. or 1 grain.

Sodii Hydroxidum, Sodium Hydroxide, NaOH (Caustic Soda, Sodium Hydrate), U. S. P.—It contains not less than 90 per cent of NaOH . Preserve it in well-closed containers. If bottles are used as containers they must be made of hard glass.

PROPERTIES: It occurs in dry, white or nearly white fused masses or sticks, hard and brittle, showing a crystalline fracture. It is odorless and has a caustic taste. Exposed to the air, it deliquesces, absorbs carbon dioxide, and becomes covered with a coating of sodium carbonate. Great caution is necessary in using it, as it rapidly destroys organic tissue. It is very soluble in water and alcohol. It closely resembles potassium hydroxide in its properties, being a very strong alkali.

PREPARATION: It is made by electrolysis of sodium chloride; also by the action of slaked lime on a solution of sodium carbonate. $(\text{Na}_2\text{CO}_3 + \text{Ca}(\text{OH})_2 = 2\text{NaOH} + \text{CaCO}_3)$

ACTION AND USES: It is used in the preparation of compound cresol solution, solution of sodium hydroxide, and magma magnesia. It seldom is used internally, because it is too caustic. The dose of solution of sodium hydroxide (which is a 4.5 per cent aqueous solution of NaOH) is 1 c. c. or 15 minims; used as an antacid. As a caustic it may be used like potassium hydroxide. *The antidote is vinegar, dilute acetic acid, citric acid, lemon juice, etc.* Sodium hydroxide is used extensively in a crude, impure form for household cleaning under the name of lye.

Sodii Benzoas, Sodium Benzoate, U. S. P.—It contains, when dried to constant weight at 110°C ., not less than 99 per cent of $\text{C}_6\text{H}_5\text{COONa}$. Preserve it in well-closed containers.

PROPERTIES: It occurs as a white, amorphous, granular or crystalline powder, odorless and having a sweetish taste. It is very soluble in water and slightly soluble in alcohol. Its aqueous solution is slightly alkaline to litmus.

PREPARATION: It is made by the action of sodium carbonate on benzoic acid: $2C_6H_5COOH + Na_2CO_3 = 2C_6H_5COONa + H_2O + CO_2$.

ACTION AND USES: Occasionally given in acute rheumatic fever when salicylates can not be tolerated by the stomach. It is used extensively as a food preservative in canned goods, catsup, etc., and it is claimed that in small quantities it does no harm; this, however, is a question over which there has been much controversy.

Average dose: 1 gm. or 15 grains.

Sodii Bicarbonas, Sodium Bicarbonate, $NaHCO_3$ (Bicarbonate of Soda, Baking Soda) U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99 per cent of $NaHCO_3$. Preserve it in well-closed containers in a cool place.

PROPERTIES: It is a white, opaque powder, odorless and having a cooling, mildly alkaline taste. It is permanent in dry air, but slowly decomposes in moist air. When its aqueous solution is heated, even mildly, it loses carbon dioxide and is converted into sodium carbonate as follows: $2NaHCO_3$, which, when heated, gives $Na_2CO_3 + H_2O + CO_2$. It is fairly soluble in water, and insoluble in alcohol. Its aqueous solution is alkaline to litmus. When treated with acids it effervesces (the same thing occurs when any carbonate is treated with an acid).

PREPARATION: It is made by the Solvay Process (ammonia soda process). A concentrated solution of sodium chloride is mixed with ammonia water; carbon dioxide under pressure is forced into this mixture, resulting in the formation of sodium bicarbonate and ammonium chloride. Sodium bicarbonate is precipitated (being less soluble) and the ammonium chloride remains in solution. The reaction may be expressed: $NaCl + NH_3 + CO_2 + H_2O = NaHCO_3 + NH_4Cl$. This process also may be used in making sodium carbonate. After making the bicarbonate this may be heated, driving off carbon dioxide and water, leaving behind sodium carbonate.

ACTION AND USES: A valuable and popular antacid. It is given frequently for hyperacidity of the stomach (heartburn), but it must be remembered that while it neutralizes the acid contained in the stomach it also causes increased secretion of more acid, and may defeat the purpose for which it is given if administered over a long period. When used for heartburn it usually is combined with ammonium carbonate and oil of peppermint and given in tablet form (soda-mint tablets). It is used externally in saturated aqueous solution for the treatment of burns and poisoning by poison ivy. It may be used in the preparation of other compounds of sodium. It is the principal ingredient in baking powder. In making bread this substance, when acted upon by either alum or cream of tartar, liberates carbon dioxide, which becomes entangled in the dough and causes it to rise. The term "soda" very often is applied to this compound, but this is to an indefinite term and might mean sodium carbonate or even caustic soda.

Average dose: 1 gm. or 15 grains.

Sodii Boras, Sodium Borate (Borax, Sodium Tetraborate, Sodium Pyroborate), U. S. P.—It contains not less than 52.32 per cent nor more than 54.92 per cent of anhydrous sodium borate (sodium diborate or tetraborate), corresponding to not less than 99 per cent of the crystallized salt ($Na_2B_4O_7 + 10 H_2O$). Preserve it in well-closed containers.

PROPERTIES: It occurs as colorless, transparent prisms, or as a white powder, odorless, and having a sweetish alkaline taste. It is slightly efflorescent in warm, dry air. It is fairly soluble in water, very soluble in glycerin, and in-

soluble in alcohol. Its aqueous solution is alkaline to litmus. It has the properties of an alkali but is milder than sodium carbonate or bicarbonate. When mixed with glycerin it decomposes alkali bicarbonates with effervescence (this accounts for the effervescence in the preparation of Dobell's solution). An aqueous solution shows an alkaline reaction toward litmus, but when dissolved in glycerin it gives an acid reaction, and when the glycerin solution is largely diluted with water the reaction is changed back to alkaline.

PREPARATION: Sodium borate is found native (as sodium borate) as a crystalline deposit in the blue mud at the bottom of the Borax Lake in California, and in lakes in other parts of the world. It can be made from crude boric acid by treating with sodium carbonate.

ACTION AND USES: Sodium borate possesses mild antiseptic properties, and because of this property it is used very often in alkaline mouth washes and gargles. It is one of the ingredients in compound solution of sodium borate, N. F. (Dobell's solution). It rarely is used internally. As a household cleaning agent (borax) it is used extensively where a mild alkali is desired in the cleaning of delicate fabrics. It also is used as a food preservative.

Average dose: 0.5 gm. or 8 grains.

Sodii Bromidum, Sodium Bromide, NaBr., U. S. P.—It contains, when dried to constant weight at 100° C., not less than 98.5 per cent of pure NaBr. Preserve it in well-closed containers.

PROPERTIES: It occurs as colorless, or white, cubical crystals, or as a white powder, odorless, and having a saline taste. It is very soluble in water and fairly soluble in alcohol. Its aqueous solution is neutral or faintly alkaline to litmus. It is a very stable salt.

PREPARATION: It can be made by methods like those employed in making potassium bromide, using NaOH instead of KOH.

ACTION AND USES: It is used as a hypnotic and nerve sedative. Its action is much like that of potassium bromide, but less irritating to the stomach and less depressing.

Average dose: 1 gm. or 15 grains.

Sodii Carbonas Monohydratus, Monohydrated Sodium Carbonate, Na₂CO₃+H₂O, U. S. P.—It contains not less than 99.5 per cent of Na₂CO₃+H₂O. Preserve it in well-closed containers.

PROPERTIES: It is a white, crystalline, granular powder, odorless and having a strong alkaline taste and reaction. When exposed to the air, under ordinary conditions, it absorbs only a slight percentage of moisture; exposed to warm, dry air at or above 50° C., the salt effloresces, and at 100° C. it becomes anhydrous. It is very soluble in water and glycerin, and is insoluble in alcohol.

PREPARATION: There are three methods by which sodium carbonate may be made: LeBlanc's process, the Cryolite process, and the Solvay process. The Solvay process has been explained under sodium carbonate. (The chemical reactions involved in the LeBlanc and the Cryolite process are too complicated to treat in this book. The student is referred to standard textbooks on pharmacy for further information.)

ACTION AND USES: Because of its strong alkaline reaction and irritating effect on the stomach sodium carbonate seldom is given internally; sodium bicarbonate is preferred when the antacid effect of soda is desired. It is used extensively in the arts, entering into the manufacture of soap, glass, sodium, sodium compounds, etc. It sometimes is used in the proportion of 100 grams to 30 gallons of water in the preparation of alkaline baths. Added to water in which instruments are being boiled (1 teaspoonful to a gallon of water), it prevents their rusting (sodium bicarbonate and borax will do the same thing). It is

used in washing when a strong alkali is desired. ("Washing soda" is a term applied to sodium carbonate containing 10 molecules of water of crystallization.)

Average dose: 0.25 gm. or 4 grains.

Sodii Chloridum, Sodium Chloride, NaCl (Common Salt), U. S. P.—It contains, when dried to constant weight at 110° C., not less than 99 per cent of pure NaCl. Preserve it in well-closed containers.

PROPERTIES: Sodium chloride, one of the most stable salts known, is formed by the union of a strong base (sodium, electropositive) forming element with a strong acid (chlorine, electronegative) forming element. It occurs as colorless, transparent cubical crystals or white crystalline powder, odorless and having a saline taste. Its aqueous solution is neutral to litmus. It is very soluble in water, fairly soluble in glycerin, and slightly soluble in alcohol.

PREPARATION: It occurs in the native state as rock salt in large deposits throughout the globe. Sea water contains about 3 per cent of this salt mixed with other salts. The waters of Great Salt Lake in Utah contain about 20 per cent of NaCl. It must be purified and freed from other salts before it is fit for medicinal or domestic use.

ACTION AND USES: A teaspoonful to a glassful of tepid water is used as an emetic. As a condiment it is almost a daily necessity in the human economy. It is found in all fluids and tissues of the body except the enamel of the teeth. A weak aqueous solution is used as a gargle and nasal douche. It is used in the preparation of physiological solution of sodium chloride, U. S. P. This solution contains in every 1,000 c. c. 8.5 grams of sodium chloride, and is commonly known as normal salt solution. When this solution is to be injected intravenously it should be made with distilled water, filtered, and sterilized in an autoclave under steam pressure, at a temperature of 115° C. for 30 minutes, or by boiling it for one hour. Before sterilization the mouth of the flask should be stoppered with a pledget of sterilized purified cotton, and the stopper and upper part of the flask covered with a piece of paper tied down around the top of the flask. This solution should not be used 48 hours after sterilization. Nearly all drugs that are injected into the system, either hypodermically or intravenously, are dissolved in normal salt solution, or one slightly weaker, in order that they will be isotonic (same density as the blood) when injected into the circulation.

Average dose: 16 gm. or 240 grains dissolved in warm water as an emetic.

Sodii Citras, Sodium Citrate, U. S. P.—It contains not less than 98 per cent of $C_6H_5(OH)(COONa)_3 + 2H_2O$. Preserve it in well-closed containers.

PROPERTIES: Occurs as a white granular powder, odorless, and having a cooling saline taste. It is very soluble in water, and is insoluble in alcohol. An aqueous solution is slightly alkaline to litmus. It has the property of holding in solution certain insoluble substances, a property possessed by other alkaline citrates.

PREPARATION: It is made by the action of citric acid on sodium carbonate, $2C_6H_5(OH)(COOH)_3 + 3Na_2CO_3 = 2C_6H_5(OH)(COONa)_3 + 3CO_2 + 3H_2O$.

ACTION AND USES: An aqueous solution has the property of preventing coagulation of the blood and delaying the curdling of milk. A solution containing 2 grains of sodium citrate and 20 grains of sodium chloride to 1 fluid ounce of water (Wright's solution) is used for the irrigation of wounds and as a local application for furunculosis. For modifying cow's milk in infant feeding to prevent the formation of large curds, 1 grain of sodium citrate to 1 fluid ounce of milk may be used. Its action in preventing coagulation of the blood and delaying milk curdling is supposed to be due to the formation of calcium citrate, which does not ionize and is therefore inactive.

Average dose: 1 gm. or 15 grains.

Sodii phosphas, Sodium Phosphate, $\text{Na}_2\text{HPO}_4 + 12 \text{H}_2\text{O}$, U. S. P.—It contains not less than 39.25 per cent nor more than 44 per cent of anhydrous sodium phosphate (di-sodium-ortho-phosphate), corresponding to not less than 99 per cent of the crystallized salt ($\text{Na}_2\text{HPO}_4 + 12 \text{H}_2\text{O}$). Preserve it in well-closed containers in a cool place.

PROPERTIES: Occurs as large, colorless prisms or granular, crystalline salt, odorless, and having a cooling alkaline taste. The crystals effloresce in air. It is very soluble in water and insoluble in alcohol. An aqueous solution is alkaline to litmus. If sodium phosphate is stored in a warm storeroom, much of the water of crystallization separates and the sodium phosphate settles in the bottom of the bottle, forming a hard mass that can not be removed without breaking the bottle. This hard mass, having lost most of its water of crystallization, is much stronger than the crystalline salt.

PREPARATION: Sodium phosphate is made from the inorganic part of animal bones. Bones contain a large amount of calcium phosphate ($\text{Ca}_3(\text{PO}_4)_2$), which by a series of reactions is converted into sodium phosphate. Sodium phosphate, if not properly prepared, may contain arsenic as an impurity through the use of impure sulphuric acid in its manufacture.

ACTION AND USES: It is used as a saline cathartic, acting much like magnesium sulphate. It is administered best dissolved in warm water and given before breakfast. It is considered an excellent remedy in catarrhal jaundice and chronic gastric catarrh.

Average dose: 4 gm. or 60 grains.

Sodii Salicylas, Sodium Salicylate, $\text{NaC}_7\text{H}_5\text{O}_3$, U. S. P.—It contains, when dried to constant weight at 100°C ., not less than 99.5 per cent of pure $\text{NaC}_7\text{H}_5\text{O}_3$. Preserve it in well-closed containers, protected from heat and light.

PROPERTIES: Occurs as a white powder or scales, or as a white powder with a pink tinge, odorless, and having a sweet saline taste. Soluble in 0.9 part of water, 9.2 parts of alcohol, and soluble in glycerin. An aqueous solution is neutral or faintly acid to litmus.

PREPARATION: It is prepared by neutralizing a solution of sodium carbonate with salicylic acid, $2\text{C}_6\text{H}_4(\text{OH})\text{COOH} + \text{Na}_2\text{CO}_3 = 2\text{C}_6\text{H}_4(\text{OH})\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$.

ACTION AND USES: It is used as an antirheumatic, analgesic, and antipyretic. It is a valuable remedy in the treatment of rheumatism, tonsillitis, and influenza.

Average dose: 1 gm. or 15 grains.

Sodii Thiosulphas, Sodium Thiosulphate, $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$ (Hypo, Sodium Hyposulphite), U. S. P.—It contains not less than 63.07 per cent nor more than 67.48 per cent of anhydrous sodium thiosulphate, corresponding to not less than 99 per cent of the crystallized salt ($\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$). Preserve it in well-closed containers.

PROPERTIES: Occurs as colorless, transparent prisms, odorless and having a cooling, later a bitter taste. It is permanent in the air below 33°C ., but effloresces in dry air above that temperature; slightly deliquescent in moist air. Soluble in 0.5 part of water and insoluble in alcohol. When an aqueous solution is boiled the salt is decomposed rapidly. When brought in contact with a solution of iodine it immediately decolorizes the iodine, forming new compounds. It is capable of dissolving the halogen compounds of silver, $\text{AgBr} + \text{Na}_2\text{S}_2\text{O}_3 = \text{NaAgS}_2\text{O}_3 + \text{NaBr}$.

PREPARATION: It is made by treating calcium thiosulphate with sodium carbonate, $\text{CaS}_2\text{O}_3 + \text{Na}_2\text{CO}_3 = \text{CaCO}_3 + \text{Na}_2\text{S}_2\text{O}_3$.

ACTION AND USES: An aqueous solution of 1 in 10 may be used for various parasitic diseases of the skin. In the absence of starch it may be used for iodine poisoning. *It is the best agent for removing iodine stains from linen.* It is used extensively in photography as a fixing bath.

Average dose: 1 gm. or 15 grains.

Lithii Citras, Lithium Citrate, U. S. P.—It contains not less than 98.5 per cent of $C_3H_4(OH)(COOLi)_3 + 4H_2O$. Preserve it in air-tight containers.

PROPERTIES: It is a white granular powder, odorless, and has a cooling faintly alkaline taste. It is deliquescent on exposure to moist air. Soluble in 1.4 parts of water, and is very slightly soluble in alcohol. It imparts a crimson color to a nonluminous flame.

PREPARATION: It is made by treating lithium carbonate with citric acid; $3Li_2CO_3 + 2C_3H_4(OH)(COOH)_3 = 2C_3H_4(OH)(COOLi)_3 + 3H_2O + 3CO_2$.

ACTION AND USES: It is used as an antirheumatic, diuretic, and antilithic. Given internally it renders the urine strongly alkaline. It is employed in making the widely used "Lithia Tablets." Its action does not differ greatly from that of the other alkaline citrates.

Average dose: 0.5 gm. or 8 grains.

Aqua Ammonia Fortior, Stronger Ammonia Water, U. S. P.—An aqueous solution of ammonia (NH_3) containing not less than 27 per cent nor more than 29 per cent by weight of NH_3 . This solution deteriorates on keeping, and must be tested frequently. Preserve it in a cool place in partially filled bottles made of hard glass free from lead. Great caution should be used in handling this liquid, and it must never be tasted unless very highly diluted.

PROPERTIES: It has an excessively pungent, characteristic odor and a very caustic and alkaline taste. In its chemical properties it closely resembles the solutions of potassium or sodium hydroxide, being a strong, caustic alkali. If kept in a warm place, ammonia (NH_3) is liberated and held in the upper part of the bottle; therefore great care should be exercised in opening the bottle to see if the stopper has been secure and has not allowed the gas to escape. There is danger of the sudden escape of a large amount of gas, which might cause injury to the eyes or mucous membranes of the nose and throat by inhalation.

PREPARATION: Ammonia is a by-product in the manufacture of illuminating gas. When coal is subjected to destructive distillation ammonia is one of the products formed. The gases formed are passed through an acid solution (sulphuric or hydrochloric) and an ammonium salt is formed (ammonium sulphate or chloride, according to the acid used). This salt then is heated with lime, ammonia (NH_3) is set free, and after passing it through quicklime it is passed into water until a saturated solution is formed.

ACTION AND USES: Stronger ammonia water is never given internally. It is used in making the weaker solution of ammonia, known as ammonia water. Ammonia water is an aqueous solution of ammonia (NH_3) containing not less than 9.5 per cent nor more than 10.5 per cent by weight of NH_3 . This solution is used in making aromatic spirits of ammonia and ammonia liniment. *The antidote for ammonia water is the same as for other alkaline hydroxides (weak acids).* Inhalations of ammonia gas stimulate the heart and respiratory center. Oedema of the glottis, resulting in obstructed breathing, might result in giving inhalations of concentrated ammonia gas; therefore care should be exercised in giving inhalations to an unconscious patient.

Ammonii Chloridum, Ammonium Chloride, NH_4Cl (*Sal Ammoniac, Ammonium Muriate*), U. S. P.—It contains, when dried to constant weight at 100° , not less than 99.5 per cent of NH_4Cl .

PROPERTIES: It is soluble in 2.6 parts of water, 100 parts of alcohol, and 8 parts of glycerin. On heating it does not melt, but passes directly to the gaseous state. It is a white, granular powder, having no odor, and a cooling, saline taste.

PREPARATION: It is made by passing ammonia gas, generated at the gas works during the destructive distillation of coal in the manufacture of illuminating gas, into hydrochloric acid: $\text{NH}_3 + \text{HCl} = \text{NH}_4\text{Cl}$.

ACTION AND USES: It is a valuable stimulant expectorant and often is used in cough mixtures (Brown mixture with ammonium chloride).

Average dose: 0.3 to 1 gm. or 5 to 15 grains.

Ammonii Carbonas, Ammonium Carbonate, U. S. P.—It consists of varying proportions of a mixture of acid ammonium carbonate (NH_4HCO_3) and ammonium carbamate ($\text{NH}_4\text{NH}_2\text{CO}_2$) and yields not less than 30 per cent nor more than 32 per cent of NH_3 . Preserve it in well-closed containers in a cool place. For medicinal purposes use only the translucent portions.

PROPERTIES: It occurs in white, hard, translucent, striated masses, having an ammoniacal odor. On exposure to the air the salt looses both ammonia and carbon dioxide, becoming opaque, and finally is converted into friable, porous lumps or a white powder. It is soluble in four parts of water and is decomposed by hot water with the elimination of carbon dioxide and ammonia. Alcohol dissolves the carbamate, but leaves the acid ammonium carbonate. An aqueous solution is alkaline to litmus.

PREPARATION: It is made by the sublimation of a mixture of ammonium sulphate and calcium carbonate, $2(\text{NH}_4)_2\text{SO}_4 + 2\text{CaCO}_3 = 2\text{CaSO}_4 + \text{NH}_4\text{HCO}_3 \cdot \text{NH}_4\text{NH}_2\text{CO}_2 + \text{NH}_3 + \text{H}_2\text{O}$.

ACTION AND USES: It is used in making aromatic spirit of ammonia and solution of ammonium acetate. It is a stimulant expectorant and heart stimulant, and is used in expectorant mixtures and smelling salts. It should never be given in powdered form because it is irritating. Mixed with an equal bulk of stronger ammonia water and scented with oil of lavender, it constitutes the common smelling salts.

Average dose: 0.3 gm., or 5 grains.

Spiritus Ammoniae Aromaticus, Aromatic Spirit of Ammonia, U. S. P.—It contains ammonium carbonate, ammonia water, oil of lemon, oil of lavender, oil of myristica, alcohol, and water. For details regarding preparation see the U. S. P. It will be noted in the method of preparation that ammonium carbonate is mixed with the ammonia water and allowed to stand for 12 hours in order that the ammonium carbonate may take on water and become normal ammonium carbonate, and the acid ammonium carbonate may take on ammonia and become normal ammonium carbonate. When freshly made it is colorless, but on exposure to light it gradually acquires a yellow color.

ACTION AND USES: It is used as a stimulant in cases of fainting, for headache attended with nausea, and for acid eructations. It should be administered well diluted with water.

Average dose: 2 c. c. or 30 minims.

The alkaline earth elements and their compounds.

The alkaline earth elements are *magnesium, calcium, strontium, and barium*. They are called alkaline earth elements because their oxides have marked alkaline (basic) properties, and the compounds of these elements are found abundantly in the earth. They are all divalent and are strongly electropositive. Their compounds are not nearly as soluble as the compounds of the alkali

elements; in fact, many of their compounds are insoluble in water. The hydroxides, carbonates, and sulphates (except magnesium sulphate) are insoluble or only slightly soluble in water. Their alkaline properties are not as intense as in the case of the alkali elements (sodium, potassium, lithium), and their hydroxides are classed as mild alkalies (milk of magnesia and lime water).

Magnesii Carbonas, Magnesium Carbonate, U. S. P.—A mixture of hydrated magnesium carbonate and magnesium hydroxide, corresponding to not less than 39.2 per cent of MgO and containing not more than 0.8 per cent of CaO.

PROPERTIES: It occurs as a light, white, bulky powder, odorless, and having a slight earthy taste. It is practically insoluble in water and alcohol.

PREPARATION: It is made by mixing cold dilute solutions of magnesium sulphate and sodium carbonate: $5\text{MgSO}_4 + 5\text{Na}_2\text{CO}_3 + \text{H}_2\text{O} = 4\text{MgCO}_3 \cdot \text{Mg}(\text{OH})_2 + 5\text{Na}_2\text{SO}_4 + \text{CO}_2$.

ACTION AND USES: It is used in making solution of magnesium citrate and magnesia magma. It is given internally as an antacid and as an antidote for acid poisoning.

Average dose: 3 gm. or 45 grains.

Magnesii Sulphas, Magnesium Sulphate, MgSO₄ (Epsom Salts).—U. S. P.—It contains not less than 48.59 per cent nor more than 53.45 per cent of anhydrous magnesium sulphate, corresponding to not less than 99.5 per cent of the crystallized salt ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$). Preserve it in well-closed containers.

PROPERTIES: It occurs as small, colorless needles or prisms, without odor, and having a cooling, saline, and bitter taste. It is soluble in one part of water, almost insoluble in alcohol, and is slowly efflorescent in warm air.

PREPARATION: One of the methods of making magnesium sulphate is by the action of sulphuric acid on magnesium carbonate (mineral magnesite), $\text{MgCO}_3 + \text{H}_2\text{SO}_4 = \text{MgSO}_4 + \text{H}_2\text{O} + \text{CO}_2$.

ACTION AND USES: It is an extensively used saline cathartic. It should be given before breakfast in a saturated aqueous solution. It acts both by preventing absorption of fluid from the bowel and by drawing more fluid from the blood into the intestines. Applied externally in saturated solution on lint to swollen joints in acute arthritis, and to swollen testicles in orchitis, it relieves pain and congestion by extracting fluid from these parts. *It is the chemical antidote for poisoning by lead acetate, producing an insoluble lead sulphate.*

Average dose: 15 gm. or 4 drams.

Talcum Purificatum, Purified Talc, U. S. P.—A purified, native hydrous magnesium silicate sometimes containing a small amount of aluminium silicate.

PROPERTIES: It is a fine white powder which adheres to the skin, is free from grittiness and is slippery to the touch. It is odorless and tasteless and is insoluble in water or alcohol. When used as a filtering medium it should not be finer than No. 100 powder.

PREPARATION: It is prepared by treating ordinary talcum with several washings of dilute hydrochloric acid, which dissolves out aluminium, iron, and other salts of magnesium.

ACTION AND USES: It forms the base of nearly all cosmetic powders. It is an excellent dusting powder, being a very fine, white powder, which adheres to the skin, is free from grittiness, slippery to the touch, odorless, and tasteless. It is used in pharmaceutical operations as a filtering medium.

Calx, Calcium Oxide, CaO (Lime, Quicklime), U. S. P.—It contains, when freshly ignited to constant weight with a blast lamp, not less than 95 per cent

of CaO . It loses not more than 10 per cent of its weight on ignition. Preserve it in air-tight containers in a dry place.

PROPERTIES: It occurs in hard, white or grayish white masses or granules, or as a white powder, odorless, and having a caustic taste. When moistened with water calcium oxide becomes heated and is gradually converted into a white powder (calcium hydroxide or slaked lime; $\text{CaO} + \text{H}_2\text{O} = \text{Ca}(\text{OH})_2$). When this is mixed with four times its weight of water it becomes a smooth magma (milk of lime). A solution made by dissolving slaked lime in water is known as solution of calcium hydroxide (lime water). It is soluble in 840 mils of water, insoluble in alcohol, and soluble in glycerin.

PREPARATION: It is made by calcination (heating highly) of limestone (CaCO_3); $\text{CaCO}_3 + \text{heat} = \text{CaO} + \text{CO}_2$.

ACTION AND USES: The principal use of lime in medicine is in making limewater. Many manufacturers supply a highly purified form of lime for this purpose. The process of making limewater is very much abbreviated when this purified form of lime is used. All that is necessary is to place the lime in distilled water and the operation is completed. In the U. S. P. process, the lime first must be purified by a long and tedious process of washing. Limewater is used as an antacid, antiemetic, and as a chemical antidote for acid poisoning.

Average dose: 15 c. c. or 4 fluid drams of the limewater.

Creta Preparata, Prepared Chalk, CaCO_3 (Drop Chalk), U. S. P.—A native form of calcium carbonate freed from most of its impurities by elutriation and containing, when dried to constant weight at 200°C ., not less than 97 per cent of CaCO_3 .

PROPERTIES: Insoluble in water and alcohol. It occurs as "conical drops" containing a very fine grayish white amorphous powder, odorless and tasteless.

PREPARATION: Made by elutriation of chalk.

ACTION AND USES: It is used in compound chalk powder and in chalk mixture. It is a nonirritating astringent and antacid. It is useful in the treatment of diarrhoea due to intestinal fermentation.

Average dose: 1 gm. or 15 grains.

Barii Dioxidum, Barium Dioxide, BaO_2 . (Barium Peroxide).—Commercial anhydrous barium dioxide. It should be kept in well closed containers.

PROPERTIES: Almost insoluble in cold water, with which it forms a hydrate having an alkaline reaction. A solution of this hydrate in water is known as baryta water. When acted on by strong mineral acids a salt of the acid and hydrogen dioxide are formed (method for making solution of hydrogen dioxide).

PREPARATION: It is made by conducting oxygen over barium oxide heated to redness, $\text{BaO} + \text{O} = \text{BaO}_2$.

ACTION AND USES: It is used, in place of potassium permanganate, in the gaseous disinfection of rooms with formaldehyde. It is an oxidizing agent and when brought in contact with formaldehyde solution some of the formaldehyde is oxidized, generating sufficient heat to volatilize the bulk of the formaldehyde contained in the solution.

Compounds of zinc.

Zinci Oxidum, Zinc Oxide, ZnO , U. S. P.—It contains, when freshly ignited, not less than 99 per cent of ZnO .

PROPERTIES: It is a very fine, amorphous, white powder, free from gritty particles, without odor or taste. It gradually absorbs carbon dioxide from the air; is insoluble in water or alcohol, but soluble in ammonia water and in solution of ammonium carbonate.

PREPARATION: It is made by calcination of pure zinc carbonate; $2\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2 + \text{heat} = 5\text{ZnO} + 3\text{H}_2\text{O} + 2\text{CO}_2$.

ACTION AND USES: The four outstanding medicinal properties of zinc oxide are: nontoxic, protective, mildly astringent, and slightly antiseptic. It may be employed either in the form of a dusting powder, in an ointment, or suspended in an aqueous mixture. The most popular of these is zinc oxide ointment, which is composed of 20 per cent zinc oxide and 80 per cent benzoinated lard. Zinc oxide is given rarely internally.

Zinci Sulphas, Zinc Sulphate, $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ (White Vitriol), U. S. P.—It contains not less than 55.86 per cent nor more than 58.65 per cent of anhydrous zinc sulphate, corresponding to not less than 99.5 per cent of the crystallized salt ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$). Preserve it in well-closed containers.

PROPERTIES: It is a granular, crystalline powder, odorless, and having an astringent and metallic taste. It is efflorescent in dry air. Soluble in 0.6 parts of water, 2.5 parts of glycerin, and insoluble in alcohol.

PREPARATION: Made by treating metallic zinc with dilute sulphuric acid; $\text{Zn} + \text{H}_2\text{SO}_4 = \text{ZnSO}_4 + \text{H}_2$.

ACTION AND USES: It is employed as an astringent and emetic. A weak aqueous solution 1–400 may be used as an eye wash, gargle, or urethral injection in gonorrhœa. It acts as a prompt emetic in 15-grain doses but, as other drugs are preferred, it seldom is used. It is used in the Navy principally as an astringent eye wash, 1 grain dissolved in 1 fluid ounce of distilled water.

Average dose: 1 gm. or 15 grains. (As an emetic.)

Compounds of aluminium.

Alumen, Alum, U. S. P.—It contains not less than 99.5 per cent of $\text{AlNH}_4(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$; or $\text{AlK}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. The label of the container must indicate whether the salt is ammonium alum or potassium alum.

PROPERTIES: It occurs as a white powder, odorless, and having a strongly astringent taste. Soluble in 7.2 parts of water, insoluble in alcohol, and fairly soluble in glycerin. Potassium alum is more soluble in water than ammonium alum. An aqueous solution of alum is acid to litmus. Ammonium alum can be distinguished from potassium alum by heating a small quantity of a sample with lime. If it is ammonium alum, ammonia will be set free from the mixture. When a hot concentrated solution of alum is poured into a hot concentrated solution of an alkaline carbonate the carbonate is decomposed with the liberation of CO_2 (similar to the action of an acid on a carbonate). This reaction is taken advantage of in the manufacture of cheap baking powders; alum mixed with sodium bicarbonate is mixed with the dough used in making bread. When the dough begins to bake the reaction starts, liberating CO_2 , which, in rising, carries the dough with it for a certain distance.

PREPARATION: Made principally from aluminium clay (silicate) by treatment with sulphuric acid and then adding potassium or ammonium sulphate, forming the double salt.

ACTION AND USES: It is used as an astringent both internally and externally. Used as a local styptic in epistaxis, external hæmorrhages, and bleeding from mucous membranes, to which the powder can be applied directly. In nose bleeding a saturated solution on pledgets of cotton sometimes is used in the nares. Barbers use it for bleeding caused by shaving. Alum is used in making exsiccated alum (burnt alum), which is alum deprived of its water of crystallization. The properties of exsiccated alum are the same as those of alum except that they are more intensified.

Average dose: 0.5 gm., or 8 grains.

Cataplasma Kaolini, *Cataplasm of Kaolin* (*Clay poultice*), N. F.—A substitute for antiphlogistine. Contains kaolin (aluminium silicate), boric acid, thymol, methyl salicylate, oil of peppermint, and glycerin. It must be thoroughly and carefully mixed, and preserved in air-tight containers.

ACTION AND USES: It acts as a mild counterirritant and exosmotic. It is applied both to superficial and deep-seated inflammations to relieve congestion, promote absorption, and relieve pain.

Compounds of iron.

Iron forms two series of chemical compounds, one, in which it has a valence of three (3), known as ferric compounds; the other, in which iron has a valence of two (2), known as ferrous compounds. The ferric compounds are distinguished by their brown color, the ferrous compounds are green. The ferric compounds are fairly stable; the tendency of the ferrous compounds is to change to the ferric condition, especially in the presence of oxidizing agents. The ferric compounds are oxidizing agents; the ferrous compounds are reducing agents. Ferrous compounds are made by the action of an acid on an electronegative element (iodine) on metallic iron, excluding the air (oxygen), which is an oxidizing agent, to prevent oxidation to the ferric state. Ferric compounds are made by oxidizing ferrous compounds. The principal effect of iron on the system is that it increases the amount of hæmoglobin in the blood (hæmatinic) resulting in an improvement in the functions of the various organs of the body, to which its tonic effect is due. Both locally and internally iron acts as an astringent. The astringent properties of the different compounds vary, some being very active astringents while others are very mild. Most of the compounds of iron are soluble in water. The oxide, hydroxide, and carbonate are insoluble.

Ferri Pyrophosphas Solubilis, *Soluble Ferric Pyrophosphate*.—It contains not less than 10 per cent of metallic iron. Preserve in well-closed, amber-colored bottles, protected from light.

PROPERTIES: Occurs as thin, apple-green, transparent scales, odorless, saline taste, soluble in water, insoluble in alcohol, and contains an amount of salt corresponding to 10 per cent of the metallic iron.

ACTION AND USES: It is an excellent iron preparation because of its mild taste, solubility, and the large amount of iron which it contains.

Average dose: 0.2 gm., or 3 grains.

Tinctura Ferri Chloridi, *Tincture of Ferric Chloride* (*Tincture of Chloride of Iron*), U. S. P.—A hydroalcoholic solution containing ferric chloride (FeCl_3) (about 13 per cent) corresponding to not less than 4.48 per cent of Fe. Protect tincture of ferric chloride from light.

PROPERTIES: A bright, amber-colored liquid, having a slightly ethereal odor, a very astringent, styptic taste, and an acid reaction.

PREPARATION: It is made by mixing 350 c. c. of solution of ferric chloride with sufficient alcohol to make 1,000 c. c. The mixture is placed in amber-colored, glass-stoppered bottles, and kept for three months before dispensing.

ACTION AND USES: It should be administered well diluted with water, and taken through a glass tube. The mouth should be thoroughly rinsed to avoid injury to the teeth. It is a valuable chalybeate (iron) tonic and styptic. It also has slight diuretic properties. It is used in making solution of iron and ammonium acetate (Basham's mixture).

Average dose: 0.5 c. c., or 8 minims.

Tinctura Ferri Citro-Chloridi, *Tincture of Ferric Citro-Chloride* (*Tasteless Tincture of Ferric Chloride*, *Tasteless Tincture of Iron*), N. F.—It is a hydro-

alcoholic solution made by dissolving sodium citrate in solution of ferric chloride and adding a small amount of alcohol and much water. It resembles in properties the scale salts of iron, except that it is a solution. It contains the same per cent of metallic iron that tincture of ferric chloride contains but in a different form.

ACTION AND USES: It is used in making elixir of iron, quinine, and strychnine, N. F. Its medicinal properties are practically the same as those of tincture of ferric chloride, U. S. P., except that it is milder.

Average dose: 0.5 c. c., or 8 minims.

Pilula Ferri Carbonatis, Pills of Ferrous Carbonate (Blaud's Pills), U. S. P.—Each pill contains not less than 0.06 gram (1 grain) of FeCO_3 .

PREPARATION: Made by the action of potassium carbonate on ferrous sulphate, $\text{FeSO}_4 + \text{K}_2\text{CO}_3 = \text{FeCO}_3 + \text{K}_2\text{SO}_4$. The pills do not keep unless well coated to exclude oxygen. If kept on hand for a long time the ferrous carbonate is changed to the ferric state. When these pills are made in the dispensary they should be used as soon as possible after their preparation. They never should be prepared and kept in stock for issue. These pills are on the supply table.

ACTION AND USES: Valuable iron tonic. Used in the treatment of anemias.

Average dose: 2 pills, which contain 2 grains of ferrous carbonate.

Compounds of arsenic.

Liquor Potassii Arsenitis, Solution of Potassium Arsenite (Fowler's Solution, Liquor arsenicalis Fowleri, P. I.), U. S. P.—An aqueous solution containing potassium arsenite, corresponding in amount to not less than 0.975 per cent nor more than 1.025 per cent of As_2O_3 . Preserve the solution in amber-colored bottles.

PROPERTIES: A clear, faintly opalescent liquid, with a pink color, and a slight odor of lavender. It is alkaline to litmus.

PREPARATION: It is made by boiling together potassium bicarbonate and arsenic trioxide in the proportion to give a finished solution having the above strength. It is held that the following reaction takes place: $\text{As}_2\text{O}_3 + 4 \text{KHCO}_3 = 2\text{K}_2\text{HASO}_3 + \text{H}_2\text{O} + 4\text{CO}_2$.

ACTION AND USES: It is a useful remedy against protozoal affections. Used in the treatment of malaria and relapsing fever; in the treatment of certain chronic skin affections, as psoriasis, lichen planus, chronic eczema, chronic urticaria, etc. It stimulates the action of the blood-forming organs, especially the bone marrow, to which its alterative and tonic properties are largely due. It is a poison and must be handled with great care.

Average dose: 0.2 c. c., or 3 minims.

Arsphenamina, Arsphenamine, Salvarsan, "606."—Also known under such trade names as arsenobezol and arsaminol. It is diamino-dihydroxyl-arsenobenzene-hydrochloride. Corresponds to 31.57 per cent arsenic.

PROPERTIES: A yellowish, crystalline, hygroscopic powder, very unstable in air, and put up in sealed ampules.

ACTION AND USES: A specific remedy for syphilis in all stages, but it is the more efficient the more recent the infection; it is also useful in various spirillar diseases, such as relapsing fever, Vincent's angina, etc.

Average dose: 0.3 to 0.6 gm., or 5 to 9 grains, administered intravenously.

Neoarsphenamina, Neoarsphenamine, Neosalvarsan.—The name applied to a mixture, sodium-diamino-dihydroxy-arsenobenzene-methanal-sulphoxylate with inert, inorganic salts. The arsenic content of 3 parts of neoarsphenamine is approximately equal to 2 parts of arsphenamine.

PROPERTIES: Yellowish, crystalline, hygroscopic powder, and very unstable in air.

ACTION AND USES: Essentially the same as those of arsphenamine, although many observers claim better results. It differs from arsphenamine in that it dissolves readily in sterile water, making a neutral solution which can at once be injected. Water not warmer than from 20° to 22° C. (68° to 71.6° F.) should be used in dissolving the drug and the injections should be made at once, as it oxidizes rapidly and becomes toxic.

Average dose: 0.6 to 0.9 gm., or 9 to 14 grains.

Compounds of antimony.

Antimonii et Potassii Tartras, Antimony and Potassium Tartrate (Antimonyl Potassium Tartrate, Tartrated Antimony, Tartar Emetic), U. S. P.—It contains not less than 98.5 per cent of $C_2H_2(OH)_2.COOK.CO O(SbO) + \frac{1}{2} H_2O$. I reserve it in well-closed containers.

PROPERTIES: Occurs as a white powder or colorless transparent crystals which become opaque on exposure to air. Disagreeable metallic taste, odorless. The crystals effloresce on exposure to air. Soluble in 12 parts of cold water, 3 parts of boiling water, 15 parts of glycerin, and insoluble in alcohol. Its aqueous solution is acid to litmus.

PREPARATION: It is made by boiling antimony oxide with potassium bitartrate. $2C_2H_2(OH)_2.CO OH.CO O K + Sb_2O_3 = 2C_2H_2(OH)_2.CO O(SbO).CO O K + H_2O$.

ACTION AND USES: It is used as an expectorant and (rarely) emetic. It is one of the ingredients contained in compound mixture of glycyrrhiza, U. S. P. (Brown mixture).

Average dose: As an expectorant and diaphoretic, 0.005 gm. or $\frac{1}{12}$ grain; as an emetic, 0.03 to 0.065 gm., or $\frac{1}{2}$ to 1 grain.

Compounds of bismuth.

Bismuthi Subnitrates, Bismuth Subnitrate, U. S. P.—A basic bismuth nitrate of varying chemical composition, which, when dried for 24 hours in a desiccator over sulphuric acid, yields, upon ignition, not less than 79 per cent of bismuth oxide (Bi_2O_3).

PROPERTIES: A heavy white powder, odorless, tasteless, and slightly hygroscopic. Almost insoluble in water and alcohol, readily soluble in hydrochloric or nitric acid. It is slightly acid in reaction.

PREPARATION: It is made by dissolving metallic bismuth in nitric acid and treating the resulting solution with sodium carbonate which precipitates the bismuth as subcarbonate (here the bismuth is freed from arsenic); the subcarbonate is redissolved with nitric acid, forming bismuth nitrate, which is converted to the subnitrate by treatment with ammonia water; the precipitate then is collected, washed, and dried.

ACTION AND USES: It is used internally in the treatment of gastric and intestinal disorders as a sedative astringent, especially in diarrhœa and putrefactive conditions. In large doses it coats the mucous membranes of the intestines and acts as a protective. Very large doses are given in X-ray work for the purpose of outlining the stomach and intestines. However, bismuth subcarbonate is better than the subnitrate for this purpose because it is less toxic. When applied to the skin on wounds or mucous membranes it acts as a protective, astringent, and antiseptic. It is used in the preparation of bismuth magma, U. S. P.

Average dose: 0.32 to 2 gm., or 5 to 30 grains.

Bismuthi Subgallus, Bismuth Subgallate (Dermatol), U. S. P.—A basic bismuth gallate of varying chemical composition which, when dried to constant weight at 100° C., yields upon ignition not less than 52 per cent nor more than 57 per cent of bismuth oxide (Bi_2O_3).

PROPERTIES: A bright yellow, amorphous powder, odorless and tasteless. Insoluble in water or alcohol.

PREPARATION: It is made by treating an acetic acid solution of bismuth nitrate with gallic acid.

ACTION AND USES: Its action and uses are similar to those of bismuth subnitrate. It is used externally as a dusting powder, under the name of dermatol.

Average dose: 0.5 gm., or 8 grains.

Compounds of lead.

Plumbi Acetas, Lead Acetate, (Sugar of Lead), U. S. P.—It contains not less than 85.31 per cent nor more than 89.57 per cent of anhydrous lead acetate, corresponding to not less than 99.5 per cent of the crystallized salt $(\text{CH}_3\text{COO})_2\text{Pb} + 3\text{H}_2\text{O}$. Preserve it in well-closed containers.

PROPERTIES: It occurs as heavy, white, granular crystals, faintly acetous odor, and a sweetish, astringent, metallic taste; efflorescent and absorbs carbon dioxide from the air; therefore it must be kept in well-closed containers. It is soluble in 1.4 parts of water, 38 parts of alcohol, and is freely soluble in glycerin. An aqueous solution is alkaline to litmus.

PREPARATION: It is made by treating lead oxide with acetic acid. $\text{PbO} + 2\text{CH}_3\text{COOH} = (\text{CH}_3\text{COO})_2\text{Pb} + \text{H}_2\text{O}$.

ACTION AND USES: It is used internally combined with opium (lead and opium pill containing 1 grain each), as a sedative astringent in diarrhœa. It is used in the preparation of lotion of lead and opium, N. F., which is used externally as a sedative astringent application to sprains and bruises. A 1 per cent solution in alcohol is used externally for ivy poisoning.

Average dose: 0.06 gm. or 1 grain.

Compounds of mercury.

Hydrargyrum, Mercury, Hg. (Quicksilver) U. S. P.—It contains not less than 99.5 per cent of Hg. Preserve it in strong, well-closed containers.

PROPERTIES: A shining, silver-white, liquid metal, odorless and tasteless. It solidifies at -40°C . and boils at 358°C . The specific gravity is 13.5; insoluble in ordinary solvents, but readily soluble in nitric acid. Mercury forms two series of compounds: *Mercurous*, in which mercury has a valence of one, and *mercuric*, in which it has a valence of two.

PREPARATION: It is made by roasting sulphide of mercury (cinnabar), forming mercury and sulphur dioxide.

ACTION AND USES: In its massive form mercury has very little action on the system, but when reduced to a fine state of subdivision it is capable of absorption either by the skin or mucous membranes and produces the physiological effects of its salts. It is contained in a fine state of subdivision, diluted with various vehicles in the following preparations: *Mercury with Chalk, U. S. P.*; *Mass of Mercury, U. S. P.*; *Mercurial Ointment, U. S. P.*; *Diluted Mercurial Ointment, U. S. P.*; and *Mercury Petrozolin, N. F.*

Massa Hydrargyri, Mass of Mercury (Blue Mass, Blue Pill), U. S. P.—It contains not less than 32 per cent nor more than 34 per cent of Hg. Preserve the product in well-closed containers.

PROPERTIES: It contains metallic mercury in a very fine state of subdivision, incorporated with oleate of mercury, glycyrrhiza, althæa, glycerin, and honey of rose. The mercury must be so fine that it is not visible under a lens magnifying 10 diameters.

PREPARATION: See U. S. P.

ACTION AND USES: It is used as purgative and cholagogue.

Average dose: 0.25 gm. or 4 grains.

Unguentum Hydrargyri, Mercurial Ointment, U. S. P.—A mixture of 50 per cent metallic mercury incorporated with oleate of mercury, prepared suet, and benzoinated lard. The mercury should be so finely divided that it is not visible under a lens magnifying 10 diameters.

PREPARATION: See U. S. P.

ACTION AND USES: It is used in the preparation of diluted mercurial ointment, U. S. P. The constitutional effects of mercury are obtained by rubbing the ointment on the skin, from which a part of the mercury is absorbed. Mercury inunctions are used in the treatment of syphilis; 2 grams of the ointment should be rubbed into a chosen area of the skin at night, followed by cleaning the part in the morning. A new area should be selected for the following night to avoid irritation of the skin. Dilution of the ointment with hydrous wool fat facilitates absorption and prevents irritation. Dilute mercurial ointment is used as a parasiticide in the destruction of crab lice. It is used also in the treatment of glandular swellings.

Oleatum Hydrargyri, Oleate of Mercury, U. S. P.—It is a preparation made by heating yellow mercuric oxide with oleic acid, resulting in the formation of a mercury salt of oleic acid (mercury soap) dissolved in an excess of oleic acid. It should be preserved in tightly closed containers protected from strong light, and it should not be dispensed if globules of mercury are visible at the bottom of the container.

PREPARATION: See U. S. P.

ACTION AND USES: It is used in the preparation of mercurial ointment, U. S. P. and may be used for the same purposes the ointment is used for. It rarely is used alone.

Hydrargyri Oxidum Flavum, Yellow Mercuric Oxide, U. S. P.—It contains, when dried to constant weight of 150° C., not less than 99.5 per cent of HgO. Preserve it in well-closed containers, protected from light.

PROPERTIES: A light orange-yellow amorphous heavy powder; odorless and having a metallic taste; turns darker on exposure to light, and is almost insoluble in water; insoluble in alcohol.

PREPARATION: Made by precipitating a solution of mercuric chloride with sodium hydroxide: $\text{HgCl}_2 + 2\text{NaOH} = \text{HgO} + \text{H}_2\text{O} + 2\text{NaCl}$.

ACTION AND USES: It is not given internally. Externally in the form of an ointment (2 grains to an ounce of petrolatum or wool fat) it is used in the treatment of conjunctivitis, blepharitis, etc.

Hydrargyri Chloridum Corrosivum, Corrosive Mercuric Chloride, HgCl₂ (Bichloride of Mercury, Corrosive Sublimate, Mercuric Chloride, Perchloride of Mercury), U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99.5 per cent of HgCl₂. Preserve it in well-closed containers. It is a poison and great caution should be used in tasting this substance.

PROPERTIES: It occurs as heavy, colorless, rhombic crystals, or crystalline masses, or as a white powder, odorless, permanent in the air, and having a metallic taste. Soluble in 13.5 parts of water, 3.8 parts of alcohol, 12 parts of glycerin, and 22 parts of ether. Its aqueous solution is acid to litmus, which becomes neutral upon the addition of sodium chloride. Its solubility in water is enhanced by the addition of sodium chloride or ammonium chloride. If an aqueous solution is exposed to light, it undergoes partial decomposition, with precipitation of calomel. This can be prevented by the addition of ammonium chloride or a few drops of hydrochloric acid.

PREPARATION: It is made by heating a mixture of mercuric sulphate and sodium chloride in a retort. A reaction takes place forming mercuric chloride

and sodium sulphate. The mercuric chloride is volatilized by the heat and condensed in a separate container (sublimation), while the sodium sulphate remains in the retort. $\text{HgSO}_4 + 2\text{NaCl} = \text{HgCl}_2 + \text{Na}_2\text{SO}_4$.

ACTION AND USES: Its chief use is as a disinfectant and antiseptic. It may be used in aqueous solution in strengths ranging from 1-1,000 to 1-10,000. It does not have a great penetrating disinfectant action because it combines chemically with organic matter. It is very irritant to the skin and must be cautiously used. When used for irrigation of body cavities (vagina), or when applied to the skin, it may be absorbed in sufficient quantity to produce toxic effects. It is given intramuscularly in the treatment of syphilis. When mixed with an excess of potassium iodide, it forms in solution, mercuric potassium iodide ($\text{HgI}_2 \cdot 2\text{KI}$), which is given by mouth in the treatment of syphilis and is known as specific mixture. Bichloride of mercury is prepared in tablet form (poison tablets of corrosive mercuric chloride, U. S. P.) as a convenient method for making up solutions of bichloride. Each tablet contains 0.5 gram of bichloride and 0.5 gram of sodium chloride, and is colored blue with sodium indigotin-disulphonate. When one of these tablets is dissolved in 500 c. c. (1 pint) of water, it makes a 1-1,000 solution; 1 tablet to a quart of water makes a 1-2,000 solution, etc. **Toxicology:** *Administer white of an egg, followed by emetic.* Opium may be given to relieve the pain. Calcium sulphide, both by mouth and intravenously, has been suggested as an antidote.

Average dose: 0.003 gram or 1/20 grain.

Hydrargyri Chloridum Mite, Mild Mercurous Chloride, HgCl, (Calomel, Mercurous Chloride, Protochloride of Mercury, Subchloride of Mercury), U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99.6 per cent of HgCl . Preserve it in well-closed containers, protected from light.

PROPERTIES: It is a white impalpable powder, turning yellowish white on being triturated with pressure; odorless, tasteless, and permanent in the air. Insoluble in water, alcohol, ether, or cold dilute acids. It should not contain the slightest trace of bichloride of mercury. It undergoes changes when exposed to light, or in contact with alkaline chlorides, bromides, or iodides, resulting in the production of mercuric salts which are toxic.

PREPARATION: The process for making calomel is similar to that for making bichloride except that metallic mercury is added. Mercury, mercuric sulphate, and sodium chloride are heated together in a retort, resulting in the formation of calomel, which is sublimed and condensed in a separate container. $\text{Hg} + \text{HgSO}_4 + 2\text{NaCl} = 2\text{HgCl} + \text{Na}_2\text{SO}_4$. After sublimation the calomel is washed several times with distilled water to free it from bichloride of mercury.

ACTION AND USES: Used externally as an antiseptic dusting powder and in ointments ($33\frac{1}{3}$ per cent) as a venereal prophylactic. Internally it is used as an alterative, cathartic, and diuretic. When calomel is given for its purgative effect it should be followed from four to six hours after administration by a normal dose of epsom salts.

Average dose: Laxative, 0.15 gm. or 2.5 grains. Alterative, 0.015 gm. or $\frac{1}{4}$ grain.

Unguentum Hydrargyri Nitratis, Ointment of Mercuric Nitrate (Citrine Ointment), U. S. P.—It is made from nitric acid, mercury, and lard. Two reactions are involved in the preparation of this ointment: (1) Nitric acid acts on the mercury, forming mercuric nitrate; (2) another portion of the nitric acid acts on the lard, forming a substance called elaidin. Finally the mercuric nitrate is incorporated with the elaidin. Contact of metallic instruments must be avoided because of the presence of free nitric acid.

ACTION AND USES: It is a stimulating application to chronic and parasitic skin diseases. If used extensively it should be diluted. Toxic symptoms from absorption should be watched for.

Hydrargyri Salicylas, Mercuric Salicylate (Mercuric Subsaliolate), U. S. P.—A compound of mercury and salicylic acid containing not less than 54 per cent nor more than 59.5 per cent of Hg. Preserve it in well closed containers protected from light.

PROPERTIES: A white, slightly yellowish or slightly pinkish powder; odorless and tasteless; insoluble in water or alcohol. Soluble in warm solutions of alkali halides forming double salts.

PREPARATION: It is made by heating yellow mercuric oxide with salicylic acid and a little water until a white mixture results. $\text{HgO} + \text{C}_6\text{H}_4(\text{OH}).\text{COOH} = (\text{C}_6\text{H}_4(\text{OH}).\text{COO})_2\text{Hg} + \text{H}_2\text{O}$.

ACTION AND USES: Used in the treatment of syphilis. It is given intramuscularly suspended in liquid petrolatum (1 grain to 10 minims of oil). It possesses the advantage of being less irritant than the other salts of mercury, both to the intestinal tract and when given intramuscularly.

Average dose: 0.004 gm. or 1/15 grain. (More than this may be given.)

Hydrargyrum Ammoniatum, Ammoniated Mercury, HgNH_2Cl (White Precipitate), U. S. P.—It contains mercurammonium chloride (HgNH_2Cl) corresponding to not less than 78 per cent nor more than 80 per cent of Hg. Preserve it in well-closed containers, protected from light.

PROPERTIES: A white, amorphous powder, odorless, and having an earthy, afterwards styptic, metallic taste; permanent in the air; insoluble in water or alcohol.

PREPARATION: Made by precipitating a solution of mercuric chloride with ammonia water. $\text{HgCl}_2 + 2\text{NH}_4\text{OH} = \text{HgNH}_2\text{Cl} + 2\text{H}_2\text{O} + \text{NH}_4\text{Cl}$.

ACTION AND USES: Taken internally it acts as an irritant poison. It is used externally in the form of an ointment (from 2 to 10 per cent) in the treatment of parasitic skin diseases. It acts as an antiseptic and local stimulant.

Ointment of Ammoniated Mercury (White Precipitate Ointment), U. S. P., contains 10 per cent ammoniated mercury with white petrolatum and hydrous wool fat.

Hydrargyrum Succinimidum, Mercuric Succinimide.—It is a white crystalline powder, soluble in 20 parts of cold water and in 5 parts of hot water. This salt, as well as its solution, should be protected from light.

ACTION AND USES: It is given hypodermically in the treatment of syphilis and pyorrhœa.

Average dose: By hypodermic, $\frac{1}{2}$ grain. It is on the supply table in $\frac{1}{2}$ -grain hypodermic tablets.

Hydrargyri Iodidum Flavum, Yellow Mercurous Iodide, HgI (Mercurous Iodide, Protoiodide of Mercury, Yellow Iodide of Mercury), U. S. P.—It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99 per cent of HgI . Preserve it in well-closed containers, protected from light.

PROPERTIES: A bright yellow amorphous powder, odorless and tasteless. It undergoes decomposition into mercury and mercuric iodide when exposed to light. It is nearly insoluble in water, insoluble in alcohol and ether.

PREPARATION: Made by treating mercurous nitrate with potassium iodide, $\text{HgNO}_2 + \text{KI} = \text{HgI} + \text{KNO}_3$.

ACTION AND USES: It is given by mouth in pill form to obtain the constitutional effects of mercury.

Average dose: 0.01 gm. or $\frac{1}{4}$ grain. It is on the supply table in 0.01 gm. or $\frac{1}{4}$ -grain pills.

Compounds of silver.

Argentum Nitras, Silver Nitrate, AgNO₃, U. S. P.—It contains, when finely powdered and dried to constant weight in a desiccator over sulphuric acid, in the dark, not less than 99.8 per cent of AgNO₃. Preserve it in dark amber-colored vials, protected from light.

PROPERTIES: Occurs in colorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light or in the presence of organic matter; odorless, and having a bitter, caustic and strongly metallic taste. Soluble in 0.4 part of water, and in 30 parts of alcohol.

PREPARATION: It is made by dissolving silver in nitric acid with the aid of heat, $3\text{Ag} + 4\text{HNO}_3 = 3\text{AgNO}_3 + 2\text{H}_2\text{O} + \text{NO}$.

ACTION AND USES: Silver nitrate is an antiseptic and disinfectant even in a very weak solution (1-1,000). Weak solutions are astringent and stimulating to mucous membranes, and strong solutions are caustic. Solutions of silver nitrate always should be made with distilled water. It is used externally as a caustic and stimulant to tissues that heal slowly; internally, as an astringent and stimulant in the treatment of gastric ulcer. To ulcerated tonsils, application is made of solution containing from 2 to 10 per cent, followed by rinsing the mouth with salt solution. Silver nitrate is given best internally in pill form. The pill should be made by mixing the drug with kaolin and petrolatum.

Average dose: 0.01 gm. or $\frac{1}{4}$ grain. It must be used with great caution. *Antidote: Sodium chloride (salt).*

Argentum Nitras Fusus, Molded Silver Nitrate (Fused Silver Nitrate, Lunar Caustic), U. S. P.—It contains not less than 94.5 per cent of AgNO₃. Preserve it in dark amber-colored vials protected from light.

PROPERTIES: It is a white, hard solid, generally in the form of pencils or cones, having the characteristic properties of silver nitrate.

PREPARATION: It is made by fusing together, at as low a temperature as possible, 4 grams of hydrochloric acid with 100 grams of silver nitrate; the fused mass then is molded. Silver chloride is formed by the action of some of the silver nitrate on the hydrochloric acid, and when the mixture is cooled it makes a solid mass.

ACTION AND USES: It is used as a caustic in the removal of warts, excessive granulations, etc.

Argentum Proteinicum, Silver Protein.—It is a protein compound of silver containing about 8 per cent of silver.

PROPERTIES: It is a brown, amorphous powder, soluble in water. It is not precipitated from solution by sodium chloride. It is decomposed by and decomposes a solution of mercuric chloride (bichloride of mercury); therefore, if penis syringes stained with this solution are kept in a bichloride solution, it is only a question of a short time before all the bichloride in the solution will be decomposed and the solution no longer will be antiseptic.

ACTION AND USES: It is used as an injection in gonorrhœal prophylaxis and treatment in one-half per cent aqueous solution. In the preparation of silver proteid solutions the powder should be sprinkled on distilled water in a graduate having a wide mouth, and it should be allowed to dissolve without stirring.

Argentum Colloidale, Colloidal Silver.—It is a colloidal compound of silver oxide with a derived protein, containing 20 to 25 per cent of silver.

PROPERTIES: It occurs in dark, brown scales, very soluble in water (forming colloidal suspension rather than true molecular solution). Like protein silver, it decomposes bichloride of mercury solutions and in turn is decomposed by the bichloride. Its stains may be removed by bichloride of mercury solution, 2 to 30 per cent in strength.

ACTION AND USES: It is slightly antiseptic and nonirritating to mucous membranes. It is used in the treatment of inflamed sensitive mucous membranes, particularly in gonorrhœa, conjunctivitis, and other infections of the urethra, eye, ear, nose, and throat. Solutions should be made with distilled water.

Compounds of copper.

Cupri Sulphas, Copper Sulphate, CuSO_4 (Blue Vitriol, Cupric Sulphate), U. S. P.—It contains not less than 62.97 per cent nor more than 66.79 per cent of anhydrous copper sulphate, corresponding to not less than 98.5 per cent of the crystallized salt ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$). Preserve it in well-closed containers.

PROPERTIES: It occurs as deep-blue crystals, or as a blue, granular powder; odorless, having a metallic taste; slowly efflorescent in dry air; soluble in 2.5 parts of water, 500 parts of alcohol, and 2.8 parts of glycerin. Its aqueous solution is acid to litmus.

PREPARATION: It is made by the action of sulphuric acid on copper. $\text{Cu} + 2\text{H}_2\text{SO}_4 = \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$.

ACTION AND USES: Internally it is used as an emetic, astringent, and antidote for phosphorus poisoning. In small doses it acts as an astringent, while in large doses it is an irritant and is nauseating. It is astringent and antiseptic even in strength of 1 to 1,000. Its aqueous solution is very destructive to the lower forms of plant life. It is used in the preparation of Fehling's solution, a reagent used in testing for the presence of sugar in urine.

Average dose: 0.25 gm. or 4 grains as an emetic; 0.01 gm. or $\frac{1}{8}$ grain as an astringent.

ORGANIC MATERIA MEDICA.

In the study of inorganic materia medica it was found that most of the substances were obtained or derived from the mineral kingdom. In the study of organic materia medica it will be found that most of the substances are obtained or derived from the vegetable and animal kingdoms or made synthetically. *Organic materia medica is the study of those compounds of carbon that are used in medicine.* In this chapter only those used in the Medical Department of the Navy are discussed. The substances have been divided into groups, as far as practicable, according to a chemical classification.

Hydrocarbons.

Hydrocarbons are chemical compounds formed by the union of the elements hydrogen and carbon. There are hundreds of these compounds but only a few are on the supply table. For details concerning the general properties of the hydrocarbons the student is referred to textbooks on chemistry.

Petrolatum, Petrolatum (Petrolatum Ointment, Petroleum Jelly), U. S. P.—A purified mixture of semisolid hydrocarbons, obtained from petroleum.

PROPERTIES: It is an unctuous mass; yellowish to light amber in color; transparent in thin layers; amorphous, and free from odor and taste. It is insoluble in water, almost insoluble in alcohol, soluble in ether, chloroform, oil of turpentine, benzene, or in most fixed or volatile oils. It melts between 38° and 54° C. Chemically it is very stable and does not turn rancid like vegetable oils and animal fats. It remains unchanged (does not saponify) when brought in contact with strong acids or alkalies.

PREPARATION: It is an intermediate product in the distillation of crude petroleum. It comprises a part of the residue left after distillation of the lighter substances.

ACTION AND USES: It is used as a bland, neutral, protective dressing, and as a base for ointments. The absorption and rapidity of action of drugs is retarded when incorporated with petrolatum; therefore it should not be used as an ointment base when absorption of a drug is desired. Given internally it is not absorbed from the intestinal tract: it acts as a lubricant and may be used in gastrointestinal irritation. *White petrolatum*, U. S. P., is petrolatum that has been decolorized.

Petrolatum Liquidum, Liquid Petrolatum (Mineral Oil, Liquid Paraffin), U. S. P.—A mixture of liquid hydrocarbons obtained from petroleum. Preserve it in well-closed containers, protected from light. The U. S. P. recognizes two kinds of liquid petrolatum: heavy liquid petrolatum having a viscosity of not less than 3.1, which is intended to be used as a laxative; light liquid petrolatum having a viscosity of not more than 3.0 and intended to be used as a solvent in making sprays.

PROPERTIES: Both varieties are colorless, transparent, oily liquids; free or nearly free from fluorescence, odorless and tasteless when cold; insoluble in water or alcohol, but soluble in ether, chloroform, or in fixed or volatile oils. Dissolves menthol, camphor, and volatile oils.

PREPARATION: It is made from crude petroleum after removal of the lighter hydrocarbons (gasoline, kerosene, etc.) by distilling the residue between 330° and 390° C. It should be noted that the definition does not state that it is a mixture of hydrocarbons of any particular chemical series.

ACTION AND USES: Largely used in the treatment of constipation. Its action is mechanical, as it is not absorbed. It simply oils the entire intestinal tract and facilitates the passage of the fecal mass. Used as a vehicle in the preparation of the oil sprays for the nose and throat and in the preparation of petroxolins (N. F. preparations).

Average dose: 15 mils or 4 fluid drams).

Paraffinum, Paraffin, U. S. P.—A purified mixture of solid hydrocarbons, usually obtained from petroleum.

PROPERTIES: It is a colorless or white, more or less translucent mass, crystalline when separating from solution, without odor or taste, and slightly greasy to the touch. It is insoluble in water or alcohol, but freely soluble in ether, benzene, volatile oils, and most fixed oils when warm. Like vaseline, it is chemically inactive and resistant to the action of other chemicals. It melts between 50° and 57° C.

PREPARATION: It is obtained from crude petroleum after all lighter substances are distilled off. It stands next to vaseline.

ACTION AND USES: It is used in ointments in hot climates to raise their melting points; in making paraffin paper; for sealing bottles; in making candles; and in the preparation of paraffin-wax compounds (Parresine). Parresine is a compound containing paraffin, gum elemi, Japan wax, asphalt, and eucalyptol; it melts at 49° C. and is used as a surgical dressing for burns.

Ammonii Ichthyo-sulphonas (Sulphonated Oil, Ichthyol, Ichthymat, etc.).—Ammonium ichthyol sulphonate is a product resulting from the sulphonation of the tarlike distillate obtained from "asphalt stone," a bituminous shale found in the Tyrol, and then converting the sulphonated product into an ammonium compound. It is not a hydrocarbon but is a hydrocarbon derivative.

ACTION AND USES: It is used in ointments in strengths from 10 to 40 per cent for the local treatment of erysipelas, acne vulgaris, chronic eczema, and furunculosis.

Halogen derivatives of hydrocarbons.

Halogen derivatives of hydrocarbons are compounds formed by substituting one or more halogen atoms (chlorine, bromine, fluorine, or iodine) for a corresponding number of hydrogen atoms in hydrocarbon compounds. The substitution may be done directly or indirectly. (See textbooks on chemistry.) The simplest hydrocarbon known is methane, CH_4 , which contains four hydrogen atoms united to one carbon atom. If we substitute three chlorine atoms in place of three of the hydrogen atoms in methane, we have a compound known as trichlor methane, CHCl_3 (chloroform); or if we make the substitution with three iodine atoms, we have a compound known as triiodomethane, CHI_3 (iodoform). If we substitute one chlorine atom for one hydrogen atom in ethane (C_2H_6), we have a compound known as monochlorethane, $\text{C}_2\text{H}_5\text{Cl}$ (ethyl chloride), etc.

Chloroformum, Chloroform, CHCl_3 , U. S. P.—A liquid consisting of not less than 99 per cent nor more than 99.4 per cent by weight of CHCl_3 and not less than 0.6 per cent nor more than 1 per cent of alcohol. Preserve it in well-stoppered bottles in a cool place protected from light. *Caution:* Care should be used in vaporizing chloroform in the presence of a naked flame, as noxious gases are produced.

PROPERTIES: A clear, colorless, mobile liquid, of a characteristic, ethereal odor and burning, sweet taste. Soluble in 210 parts of water; miscible with alcohol, ether, benzene, petroleum, benzin, or with fixed or volatile oils. Specific gravity, 1.474 to 1.478 at 25°C . It is volatile at a low temperature and boils at 61°C . It is not inflammable, but its heated vapor burns with a green flame. Chloroform is decomposed when exposed to light and air, liberating chlorine, hydrochloric acid, phosgene, and other compounds. The presence of a small amount of alcohol tends to prevent this decomposition. Chloroform that has been exposed to light and air should not be used for anæsthesia.

PREPARATION: It is made by the action of chlorinated lime on either acetone or ethyl chloride.

ACTION AND USES: Used in surgery as a general anæsthetic by inhalation; internally as a carminative and sedative; externally as a rubefacient and vesicant. It is used in the preparation of chloroform water, U. S. P., chloroform liniment, U. S. P., and spirit of chloroform, U. S. P.

Average dose: 0.3 c. c. of 5 minims.

Iodoformum, Iodoform, CHI_3 , U. S. P.—Triiodomethane, usually obtained by the action of iodine upon alcohol or acetone in the presence of an alkali or alkali carbonate. Preserve it in well-closed containers in a cool place, protected from light.

PROPERTIES: It occurs as a fine, lemon-yellow powder or in lustrous crystals of the hexagonal system having a peculiar, very penetrating and persistent odor and an unpleasant, slightly sweetish taste suggestive of iodine. It is nearly insoluble in water, but soluble in 60 parts of alcohol, 80 parts of glycerin, 10 parts of chloroform, 7.5 parts of ether, and in 34 c. c. of olive oil. The unpleasant odor may be partially disguised in ointments by the addition of 5 drops to the ounce of oil of peppermint. The odor of iodoform on utensils may be removed partially by wiping them off with oil of turpentine, followed by washing with soap and water.

PREPARATION: Made by the action of iodine upon alcohol or acetone in the presence of an alkali or alkali carbonate.

ACTION AND USES: It is used externally in the form of dusting powder, ointment, or iodoform gauze as an antiseptic and stimulating dressing to wounds and ulcers. Its antiseptic properties are due to iodine, of which it contains about 96 per cent. Iodoform gauze may be made by saturating surgical gauze with a 5 per cent solution of iodoform in ether and allowing to dry.

Dosage: 0.25 gm. or 4 grains. (Rarely given internally.)

Ethylis Chloridum, Ethyl Chloride ($\text{CH}_3\text{CH}_2\text{Cl}$), U. S. P.—Monochlorethane. Preserve it in hermetically sealed containers in a cool place, remote from fire and protected from light.

PROPERTIES: At low temperatures or under pressure ethyl chloride is a colorless, mobile, very volatile liquid, having a characteristic ethereal odor and a burning taste. It boils between 12° and 13° C. It burns with a smoky, greenish flame with the production of hydrochloric acid. When liberated at room temperature from its sealed container it vaporizes at once. *The gas is very inflammable and must not be used in proximity to fire.*

PREPARATION: Ethyl chloride is made by passing hydrochloric acid gas into cold absolute alcohol. $\text{C}_2\text{H}_5\text{OH} + \text{HCl} = \text{C}_2\text{H}_5\text{Cl} + \text{H}_2\text{O}$.

ACTION AND USES: When inhaled it produces general anæsthesia promptly and may be used for operations that require only a few minutes. Sprayed on a part of the body it produces refrigeration and is used as a local anæsthetic in minor operations.

Alcohols.

Alcohols are compounds formed by the replacement of one or more hydrogen atoms of a hydrocarbon (except benzene) with an equal number of hydroxyl (OH) groups. If one hydroxyl group is substituted for one hydrogen atom in methane (CH_4) an alcohol known as methyl alcohol (CH_3OH) or wood alcohol results; if one hydroxyl group is substituted for one hydrogen atom in ethane (C_2H_6) an alcohol known as ethyl alcohol ($\text{C}_2\text{H}_5\text{OH}$) or grain alcohol is obtained; if three hydroxyl groups are substituted for three hydrogen atoms in propane (C_3H_8) an alcohol known as triatomic propyl alcohol ($\text{C}_3\text{H}_7(\text{OH})_3$) or glycerin occurs. Alcohols are designated monatomic, diatomic, triatomic, etc., accordingly as they contain one, two, three, etc., hydroxyl (OH) groups. Alcohols are related closely to hydroxides or bases in inorganic chemistry, and sometimes they are referred to as organic hydroxides. When acted upon by an acid they form a salt (ester), and water which is analogous to the reaction that takes place when an acid acts on a base (hydroxide). They have a neutral reaction to litmus if pure.

Alcohol, Alcohol, $\text{C}_2\text{H}_5\text{OH}$, U. S. P.—A liquid containing not less than 92.3 per cent by weight or 94.9 per cent by volume, at 15.56° C., of $\text{C}_2\text{H}_5\text{OH}$. Preserve it in well-closed containers in a cool place, remote from fire.

PROPERTIES: It is a transparent, colorless, mobile, and volatile liquid, having a slight characteristic odor and a burning taste. Miscible in all proportions with water, ether, and chloroform. Specific gravity 0.816 at 15.56° C. (the United States Government standard temperature for alcohol), 0.810 at 25° C. It is easily volatilized at low temperature and boils at 78° C. It is inflammable and burns with a pale blue, smokeless flame.

PREPARATION: Alcohol is made by the fermentation of starch contained in grain. In making U. S. P. alcohol rectified spirit is macerated with dehydrating agents (quicklime) to remove water, and then is distilled. (For details see dispensatory.)

ACTION AND USES: Alcohol is used as a diffusible stimulant and hypnotic. Large doses cause intoxication by depression and, finally, paralysis of the central nervous system. Externally alcohol is used as a refrigerant in giving

baths and alcohol rubs. It is a valuable antiseptic and is used extensively in surgery. In pharmacy it is used as a solvent in making spirits, tinctures, elixirs, and fluid extracts. Denatured alcohol should be made as directed by the Bureau of Supplies and Accounts circular letter No. 27-1921. Average dose: 10 c. c. or 2.5 fluid drachms.

Alcohol Dilutum, Dilute Alcohol, U. S. P.—A liquid containing from 41 to 42 per cent by weight, or from 48.4 to 49.5 per cent by volume at 15.56° C. of C_2H_5OH . Preserve it in well-closed containers in a cool place, remote from fire.

PREPARATION: It is made by mixing equal volumes of U. S. P. alcohol and distilled water. When 500 c. c. of alcohol and 500 c. c. of distilled water are mixed, instead of getting 1,000 c. c. of dilute alcohol only 970 c. c. are made.

Alcohol Dehydratum, Dehydrated Alcohol, U. S. P.—A liquid commonly known as absolute alcohol and containing not less than 99 per cent by weight of C_2H_5OH . Preserve it in well-closed containers, in a cool place, remote from fire. If the stopper is removed, it should be securely replaced as soon as possible to prevent the absorption of water from the air.

PREPARATION: It is made from ordinary alcohol by redistillation after percolation through lime. There is still remaining 1 per cent of water, which is allowed.

ACTION AND USES: Absolute alcohol is used in microscopical work.

Alcohol Methylie, Methyl Alcohol, CH_3OH (Wood Alcohol, Wood Naphtha, Wood Spirit, Carbinol).—Methyl alcohol is made by the destructive distillation of wood.

ACTION AND USES: It is used in microscopical work. It is an excellent solvent, but is unfit for use in pharmacy because it is a *dangerous poison*, producing blindness and death. It is used in denaturing ethyl alcohol and in making formaldehyde.

Glycerinum, Glycerin $C_3H_5(OH)_3$ (Glycerol), U. S. P.—A liquid obtained by the hydrolysis of vegetable or animal fats, or fixed oils; purified by distillation, and containing not less than 95 per cent of the trihydric alcohol $C_3H_5(OH)_3$ or $CH_2OH.CH(OH).CH_2OH$. Preserve it in well-closed containers.

PROPERTIES: It is a clear, colorless liquid, of a thick, syrupy consistence, having not more than a slight, characteristic odor; sweet to the taste and producing a sense of warmth in the mouth; when it is exposed to the air it absorbs moisture. It is miscible with water or alcohol in all proportions; insoluble in chloroform, ether, benzene, or fixed or volatile oils.

PREPARATION: Glycerin is a by-product in the manufacture of soap. Whenever an alkali acts on a fixed oil or an animal fat a soap and glycerin are formed. The process is called saponification.

ACTION AND USES: It is extensively used in pharmacy as a solvent. It possesses the advantages of easily mixing with alcohol and water; is slightly antiseptic and preservative; has a sweet taste, and will dissolve many medicinal substances. It is used in making glycerin suppositories, glycerinated gelatin, and glycerites. It tends to keep substances from becoming hard. Given internally as a laxative (rarely).

Average dose: 4 c. c., or 1 fluidram.

Aldehydes and aldehyde derivatives.

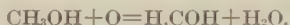
The word aldehyde is derived from alcohol dehydrogenatum, meaning alcohol from which hydrogen has been extracted, and referring to the method of preparing aldehydes. If two atoms of hydrogen are extracted from methyl alco-

hol ($\text{CH}_3\text{OH}-\text{H}_2=\text{H}.\text{COH}$), formic aldehyde or formaldehyde is formed. The extraction of the hydrogen usually is accomplished by bringing some substance in contact with the alcohol that has a greater attraction for the hydrogen than has the carbon. Such a substance is oxygen, and the process of extracting the hydrogen is called oxidation; therefore it is said that formaldehyde is made by the oxidation of methyl alcohol. When an aldehyde is oxidized (this time the oxygen is added to the carbon instead of taking something from it), it is converted into an acid ($\text{H}.\text{COH}+\text{O}=\text{H}.\text{COOH}$); when acetic aldehyde is oxidized it is converted into acetic acid: ($\text{CH}_3.\text{COH}+\text{O}=\text{CH}_3.\text{COOH}$). The aldehyde group is COH and is contained in all aldehydes.

Liquor Formaldehydi, Solution of Formaldehyde, H.COH (Formalin). U. S. P.—An aqueous solution containing not less than 37 per cent by weight of H.COH with varying amounts of methyl alcohol to prevent polymerization. Preserve it in a moderately warm place, protected from light.

PROPERTIES: It is a clear, colorless, or nearly colorless liquid having a pungent odor and a caustic taste; its vapor acts as an irritant upon mucous membranes. It is miscible with water or alcohol. On long standing, especially in the cold, solution of formaldehyde sometimes loses its transparency, the cloudiness being due to the separation of paraformaldehyde (polymerization). Chemically it is a reducing agent.

PREPARATION: It is made by the oxidation of methyl alcohol.

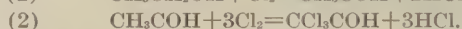
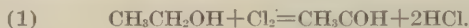


ACTION AND USES: It is a powerful antiseptic and disinfectant. It acts as a disinfectant in aqueous solution in strengths of from 1 to 2 per cent (per cent here refers to the amount of absolute ($\text{H}.\text{COH}$) formaldehyde). This strength may be used in the disinfection of the hands, linen, or surgical instruments (having cutting edges). A 1 to 10 solution in alcohol is used for the preservation of tissue. A solution composed of 12.5 c. c. of formalin, 5 gm. of borax, and water to make 100 c. c. is used as an embalming fluid. It is used as a room disinfectant with barium dioxide. Five hundred c. c. of formalin mixed with 250 gm. of barium dioxide in a suitable container will generate sufficient formaldehyde gas to disinfect 1,000 cubic feet of air space. Formaldehyde is one of the few true deodorants.

Chloralum Hydratum, Hydrated Chloral (Chloral, Chloral Hydrate), U. S. P.—A compound of trichloraldehyde or chloral, with the elements of one molecule of water. It contains not less than 99.5 per cent of $\text{C}.\text{Cl}_3.\text{COH}+\text{H}_2\text{O}$. Preserve it in tightly stoppered bottles, in a cool place, protected from light.

PROPERTIES: It occurs in colorless, transparent crystals which do not readily attract moisture. It has an aromatic, penetrating, and slightly acrid odor, and a bitterish, caustic taste. It is slowly volatilized when exposed to the air. It is soluble in 0.25 part of water, 1.3 parts of alcohol, 2 parts of chloroform, and 1.5 parts of ether; very soluble in olive oil, freely soluble in oil of turpentine. It is decomposed by alkalies, liberating chloroform.

PREPARATION: It is made by passing chlorine gas through absolute ethyl alcohol, resulting first in the conversion of alcohol to acetaldehyde, and then the acetaldehyde is converted into trichloraldehyde (chloral).



ACTION AND USES: It is a powerful nerve sedative and hypnotic and is used in insomnia, hysteria, the various forms of insanity, and delirium tremens. It usually is given with bromides. It is used to cause muscular relaxation in tetanus and strychnine poisoning, when large doses are necessary. It is a habit-

forming drug and should be used cautiously. It is one of the 11 drugs mentioned in the Federal Pure Food and Drugs Act. The amount contained in any preparation must appear on the label when it enters interstate commerce.

Average dose: 0.5 gm. or 8 grains.

Hexamethylenamina, Hexamethylenamine, C₆H₁₂N₄ (Hexamethylene-tetramine), U. S. P.—A condensation product of ammonia and formaldehyde. Preserve it in well-closed containers.

PROPERTIES: It occurs as colorless, lustrous, odorless crystals, or a white, crystalline powder; soluble in 1.5 parts of water and in 12.5 parts of alcohol. Its aqueous solution is alkaline to litmus.

PREPARATION: It is made by the action of ammonia on formaldehyde.

ACTION AND USES: It is a diuretic and antiseptic to the genito-urinary tract, as well as antiseptic for various body fluids, such as joint fluids, pleural fluids, etc. Its antiseptic action is due to formaldehyde liberated in body fluids.

Average dose: 0.25 gm. or 4 grains.

Ethers.

Ethers may be defined as oxides of hydrocarbon radicles. There are simple ethers and mixed ethers. Simple ethers are formed by the union of two like hydrocarbon radicles with one oxygen atom; $C_2H_5-O-C_2H_5$ is diethyl ether (ether); compound ethers are formed by the union of two unlike hydrocarbon radicles with one oxygen atom, $CH_3-O-C_2H_5$ is methyl ethyl ether. Ethers in organic chemistry are analogous to oxides in inorganic chemistry. The term very often is applied erroneously to esters. It should be understood clearly that ethers and esters are two different and distinct classes of organic compounds. Ethers are organic oxides, while esters are organic salts. (See textbook on chemistry.)

Ether, Ether (C₂H₅)₂O (Sulphuric Ether), U. S. P.—A liquid containing not less than 95.5 per cent nor more than 97.5 per cent of ethyl oxide ($(C_2H_5)_2O$), the remainder consisting of alcohol containing a little water. Preserve it in partially filled, well-closed containers, in a cool place, remote from fire, and protected from daylight. When ether is to be used for anaesthesia it is to be dispensed only in small, well-closed containers and is not to be used for this purpose if the container has been opened longer than 24 hours.

PROPERTIES: Ether is a transparent, colorless, mobile liquid, having a characteristic odor and a burning sweetish taste. It is soluble in 12 parts of water and is miscible with alcohol, chloroform, petroleum benzin, benzene, or fixed and volatile oils. It boils at about 35° C. It is highly volatile and inflammable. Its vapor when mixed with air and ignited will explode violently. It is slowly oxidized by the action of air, moisture, and sunlight.

PREPARATION: It is made by the action of sulphuric acid on alcohol. $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4 + H_2O$, and $C_2H_5HSO_4 + C_2H_5OH = (C_2H_5)_2O + H_2SO_4$.

ACTION AND USES: It is administered by inhalation to produce general anaesthesia. In the administration of ether great care should be exercised to see that a flame is not brought near the vapor. In pharmacy it is used as a solvent in the preparation of oleoresins and in the assay of alkaloids. Given internally it acts as a cardiac stimulant, carminative, and antispasmodic.

Average dose: 1 c. c. or 15 minims.

Phenol and phenol derivatives.

Phenols may be defined as compounds formed by the substitution of one or more hydroxyl (OH) groups for a corresponding number of hydrogen atoms that are connected directly with carbon atoms in the benzene nucleus (C_6H_6).

A phenol formed by substituting one hydrogen atom in benzene (C_6H_6) with one hydroxyl (OH) group is known as a monatomic phenol (C_6H_5OH), ordinary phenol; the substitution of two hydroxyls for two hydrogens would give a diatomic phenol ($C_6H_4(OH)_2$), resorcinol; the substitution of three hydroxyls for three hydrogens would give a triatomic phenol ($C_6H_3(OH)_3$), pyrogallol. The substitution of three nitro groups for three of the hydrogen atoms in phenol (C_6H_5OH) gives a compound known as trinitro-phenol ($C_6H_2(NO_2)_3OH$), picric acid, etc. It should be understood clearly that phenols are a distinct class of compounds. The term "phenol" is the name given to the most important member in this class, just as alcohol is the name applied to the most important member in the class of alcohol and the term "ether" to the most important member of the class of ethers.

Some of the phenols are liquids and some are solids; they all have a characteristic odor; they act like weak acids, forming salts with strong alkalies, but they do not decompose carbonates, and their reaction to litmus is neutral or only faintly acid. They are nearly all very poisonous; most of them are disinfectants or antiseptics; are soluble in alcohol and sparingly soluble in water. Some are found in the vegetable kingdom (thymol) and some are formed when complex carbon compounds are subjected to destructive distillation; wood tar and coal tar, the residues resulting from the destructive distillation of wood and coal, contain phenols (phenol and cresol). *A general measure against the caustic action of phenols (externally) is ethyl alcohol (grain alcohol), which dilutes the phenol, thereby weakening its action as well as making it easier to remove. As an internal antidote alcohol should not be used, because an alcoholic solution of phenol is rapidly absorbed.*

Phenol, Phenol, C_6H_5OH (Carbolic acid), U. S. P.—It is obtained from coal-tar or made synthetically. It contains not less than 97 per cent of C_6H_5OH . Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs as colorless, interlaced or separate needle-shaped crystals, or as a white, crystalline mass, sometimes acquiring a red tint, having a characteristic, somewhat aromatic odor. When undiluted it cauterizes and whitens the skin and mucous membrane. It is soluble in 15 parts of water; very soluble in alcohol, glycerin, chloroform, ether, or in fixed or volatile oils. When heated it melts, forming a highly refractive liquid. It also is liquefied by the addition of about 8 per cent of water.

PREPARATION: It is obtained from coal tar by fractional distillation and subsequent purification. It also is made synthetically.

ACTION AND USES. See Liquefied Phenol.

Phenol Liquefactum, Liquefied Phenol (Liquefied carbolic acid), U. S. P.—A liquid containing not less than 87 per cent of C_6H_5OH and about 12 per cent of water. Preserve it in well-closed containers, protected from the light.

PROPERTIES: It is a colorless liquid, which may develop a red tint upon keeping, having a characteristic, somewhat aromatic odor. When undiluted it cauterizes the skin and mucous membrane. It is miscible with ether, alcohol, or glycerin. When it is diluted with an equal volume of glycerin the mixture is miscible with water.

PREPARATION: It is made by melting crystallized phenol on a water bath. It then is poured into a tared vessel and weighed, and to every 9 grams of phenol is added 1 gram (1 c. c.) of distilled water, mixed thoroughly. An easier but less accurate method is to melt a bottle of the crystals on a water bath, add enough hot water to nearly fill the bottle, and shake thoroughly.

ACTION AND USES: It is a valuable antiseptic and disinfectant. A 5 per cent solution may be used for the disinfection of the hands, soiled linen, stools,

urine, bedpans, urinals, etc. In concentrated form it acts as a caustic and local anæsthetic. Applied to a tooth cavity on a piece of cotton, it relieves toothache. *If the pure phenol is spilled on the skin or in the mouth, it should be washed off immediately with alcohol.* The concentrated phenol coagulates albumin, but its weaker aqueous solutions do not. Concentrated liquefied phenol is used for the disinfection of cutting-edged instruments which are damaged by boiling: after taking the instruments out of the phenol they are rinsed in alcohol to remove all the phenol.

Average dose: 0.05 c. c. or 1 minim.

Cresol, Cresol (Trieresol), U. S. P.—A mixture of isomeric cresols, $C_6H_4.OH$. (CH_3), obtained from coal tar. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs as a colorless or yellowish to brown-yellow, highly refractive liquid, becoming darker or assuming a reddish tint with age and on exposure to light, and having a phenol-like, sometimes empyreumatic odor. It is soluble in 50 parts of water; miscible with alcohol, ether, glycerin, benzene, or petroleum benzin. It also is dissolved by solutions of the fixed alkali hydroxides and soap solutions (compound cresol solution).

PREPARATION: It is obtained from the phenol distillates of coal tar.

ACTION AND USES: The action of cresol is similar to that of phenol, except that it is stronger. It is a good disinfectant in the strength of 2 per cent solution for urinals, bedpans, stools, sputum cups, etc. It is used principally in the form of compound cresol solution, U. S. P., for disinfection of utensils, hands, and in obstetrical work, in strengths from 1 to 3 per cent. The poisonous effects of cresol are similar to those of phenol. Compound cresol solution may be prepared extemporaneously by thoroughly mixing equal parts of cresol and soft soap and letting the mixture stand at least 24 hours. The resulting mixture forms a clear solution when dissolved in water.

Trinitrophenol, Trinitrophenol ($C_6H_2(OH)(NO_2)_3$) (*Picric acid*), U. S. P.—Preserve it in well-stoppered bottles, in a cool place, remote from fire. *Caution:* For safety in transportation it usually is mixed with about 20 per cent of water.

PROPERTIES: It occurs in pale yellow, rhombic prisms or scales; odorless, and having an intensely bitter taste. *It explodes when heated rapidly and when subjected to percussion.* It is soluble in 78 parts of water, 12 parts of alcohol, 35 parts of chloroform, 65 parts of ether, and in 10 parts of benzene. Its aqueous solution is acid to litmus.

PREPARATION: It is made by the action of nitric acid on phenol, resulting in the substitution of the nitro groups (NO_2) for three hydrogen atoms in phenol.

ACTION AND USES: It is astringent and antiseptic. Its saturated aqueous solution is used mainly in the treatment of burns. Gauze saturated with the solution is applied to the burned area. A 5 per cent alcoholic solution is used (like tincture of iodine) in the first-aid-treatment of wounds as a disinfectant.

Resorcinol, Resorcinol, $C_6H_4(OH)_2$ (*Resorcin*), U. S. P.—Metadihydroxybenzene. It contains not less than 99.5 per cent of $C_6H_4(OH)_2$. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs as colorless, or nearly colorless, needle-shaped crystals: or as a powder, having a faint peculiar odor and a sweetish, followed by bitter, taste. It acquires a pink tint on exposure to air and light. It is soluble in 0.9 parts of water, 0.9 parts of alcohol, freely soluble in glycerin or ether, slightly soluble in chloroform.

ACTION AND USES: It is antiseptic and antizymotic. It seldom is given internally. It is used in the form of an aqueous solution, and an ointment in the treatment of subacute and chronic skin diseases.

Creosotum, Creosote (Creasote), U. S. P.—A mixture of phenols and phenol derivatives, chiefly guaiacol and cresol, obtained during the distillation of wood tar. Preserve it in tightly stoppered, dark amber-colored bottles.

PROPERTIES: It is an almost colorless or yellowish, highly refractive, oily liquid, having a penetrating, smoky odor, and a burning caustic taste; it does not readily become brown on exposure to light. It is slightly soluble in water, and is miscible with alcohol, ether, or fixed or volatile oils. It is inflammable.

ACTION AND USES: It is given internally as an antiemetic, intestinal antiseptic, and stimulant expectorant. The poisonous symptoms are like those of carbolic acid and the treatment is the same. Locally it acts as an anæsthetic and antiseptic which makes it suitable for use in dental practice.

Average dose: 0.25 c. c. or 4 minims. When given freely it should be administered in emulsion or dissolved in milk in order to overcome its irritating local effect.

Creosoti Carbonas, Creosote Carbonate, U. S. P.—A mixture of carbonates of various constituents of creosote, chiefly guaiacol and cresol.

PROPERTIES: It is a clear, colorless or yellowish, viscid liquid, odorless and tasteless, or having a slight odor of creosote. It is insoluble in water and freely soluble in alcohol or fixed oils.

ACTION AND USES: Being less irritating it is a good substitute for creosote internally.

Average dose: 1 gm. or 15 grains.

Guaiacol, Guaiacol (Methyl-orthodioxybenzene) U. S. P.—The monomethyl-ether ($C_6H_4(OH)OCH_3$) of ortho-dihydroxybenzene, obtained from wood-tar creosote, or prepared synthetically. Preserve it in well-closed containers, protected from light.

PROPERTIES: It is a colorless or yellowish, strongly refractive liquid or a crystalline solid having an agreeable aromatic odor. It is soluble in 53 parts of water, 0.8 parts of glycerin, and is miscible with alcohol, chloroform, ether, or acetic acid. Solid guaiacol melts at $28^{\circ}C$.

PREPARATION: It is made by the fractional distillation of beech-wood tar creosote. It also is made synthetically.

ACTION AND USES: It is used externally as an antipyretic by applying locally on the skin. 1 to 3 c. c. painted on the chest, thigh, or abdomen of a fever patient will cause a fall of several degrees in the temperature of the body in an hour followed by excessive sweating and depression. It produces partial local anæsthesia when applied externally and sometimes is used for superficial neuralgias.

Average dose: 0.5 c. c. or 8 minims.

Acetanilidum, Acetanilid (Acetanilide, Antifebrin), U. S. P.—The monoacetyl derivative ($C_6H_5NH.CH_3CO$) of aniline.

PROPERTIES: Acetanilide is an odorless, crystalline powder having a slightly burning taste; permanent in the air. It is soluble in 190 parts of water, 3.4 parts of alcohol, and 5 parts of glycerin.

ACTION AND USES: It is antipyretic, analgesic, and cardiac depressant. Used principally as a headache remedy. It has a tendency to destroy red corpuscles. It is used in solution of hydrogen dioxide as a preservative.

Average dose: 0.2 gm. or 3 grains.

Antipyrina, Antipyrine (Phenazone), U. S. P.—Phenyldimethylpyrazolon ($C_6H_7N_2O(CH_3)_2.C_6H_5$). Preserve it in well-closed containers.

PROPERTIES: It is a white, nearly odorless crystalline powder with a slightly bitter taste. It is soluble in less than one part of water.

ACTION AND USES: It is analgesic, antipyretic, and cardiac depressant.

Average dose: 0.3 gm. or 5 grains.

Acetphenetidinum, Acetphenetidin (Phenacetin), U. S. P.—The monoacetyl derivative ($C_6H_4(OC_2H_5).NH.CH_3CO$) of para-amidophenetol.

PROPERTIES: It occurs as a white powder, odorless, and having a bitter taste. It is soluble in 1,310 parts of water and 15 parts of alcohol.

ACTION AND USES: It is antipyretic, analgesic, and cardiac depressant. It is used extensively as a headache remedy.

Average dose: 0.3 gm. or 5 grains.

Organic acids and their esters.

Organic acids are compounds formed by the union of a hydrocarbon radicle with a carboxyl group ($COOH$). They also are called carboxylic acids. They are not made by directly connecting the carboxyl group to a hydrocarbon radicle but by the oxidation of an alcohol to an aldehyde, and further oxidation of the aldehyde to an organic acid. The reactions taking place in the formation of acetic acid from ethyl alcohol may be expressed as follows: $C_2H_5.OH + O = CH_3.CO.H + H_2O$. Then $CH_3.CO.H + O = CH_3.COOH$. If the acid contains only one carboxyl group ($COOH$) it is a monobasic acid; if it contains two, it is a dibasic acid; if it contains three, it is tribasic, etc. The only hydrogen that is replaceable by a metal or basic radicle in an organic acid is the hydrogen in the carboxyl group.

They possess the general properties of inorganic acids; they are sour to the taste, usually soluble in water; have a strong acid reaction to litmus. Some are liquids and some are solids. They are not as corrosive as the inorganic acids, some being very mild in their acid properties. They decompose carbonates and combine with metals and basic radicles to form salts.

Esters are compounds formed by the union of an organic and inorganic acid with a basic hydrocarbon radicle. Erroneously they sometimes are called ethers. Examples of esters are ethyl acetate, ethyl chloride, phenyl salicylate, methyl salicylate, ethyl sulphate, etc. They frequently are called organic salts.

Acidum Aceticum Glaciale, Glacial Acetic Acid, $CH_3.COOH$, U. S. P.—A liquid containing not less than 99 per cent of $CH_3.COOH$. Preserve it in glass-stoppered bottles.

PROPERTIES: It is a clear, colorless liquid with a strong, vinegar-like odor and a very pungent, acid taste. It is miscible with water or alcohol.

PREPARATION: It is one of the products resulting from the destructive distillation of wood. It may be made by oxidation of alcohol.

ACTION AND USES: It is a very energetic acid and acts as a caustic. It is used principally in the preparations of the weaker acids (acetic acid, U. S. P., 36 to 37 per cent, and dilute acetic acid, U. S. P., 5.7 to 6.3 per cent). It is used in the preparation of salts of acetic acid (acetates).

Average dose: 2 c. c. or 30 minims of the dilute acid.

Acidum Citricum, Citric Acid, U. S. P.—A tribasic organic acid usually obtained from the juice of limes or lemons. It contains not less than 99.5 per cent of $C_6H_4(OH)(COOH)_3 + H_2O$. Preserve it in well-closed containers.

PROPERTIES: It occurs as colorless, translucent prisms or as a white powder, odorless and having an acid taste, and is efflorescent in warm air. It is soluble in 0.5 part of water and 1.8 parts of alcohol.

ACTION AND USES: It is used in the preparation of citrates (solution of magnesium citrate, U. S. P.) and in the preparation of effervescent salts. It may be used as a substitute for lemon juice.

Average dose: 0.5 gm. or 8 grains.

Acidum Salicylicum, Salicylic Acid, U. S. P.—Orthohydroxybenzoic acid. It exists naturally in combination in various plants but generally is prepared synthetically. It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 99.3 per cent of $C_6H_4(OH)COOH$. Preserve it in well-closed containers.

PROPERTIES: It occurs in fine prismatic needles or in a bulky crystalline powder having a sweetish, afterwards acid taste. Synthetic salicylic acid is white and odorless; when prepared from methyl salicylate it may have a slight yellow tint and a slight gaultherialike odor. It is soluble in 460 parts of water, 2.7 parts of alcohol, and 3 parts of ether.

ACTION AND USES: Used as an antipyretic and antirheumatic. It is used principally in the preparation of the salicylates (Phenyl salicylate, U. S. P., sodium salicylate, U. S. P., and acetylsalicylic acid) which are preferred for internal use. It is used externally for the treatment of skin diseases in the form of ointment, alcoholic solution, and dusting powder. It is contained in many corn collodions.

Average dose: 0.75 gm. or 12 grains.

Acidum Acetylsalicylicum, Acetylsalicylic Acid (Aspirin).—The acetic-acid ester, $(C_6H_4O(CH_3CO).COOH)$ of salicylic acid.

PROPERTIES: It is a white crystalline powder, odorless, and having an acid taste and reaction. It is sparingly soluble in water and freely soluble in alcohol. Its aqueous solution gradually decomposes into acetic and salicylic acids.

ACTION AND USES: Its action is like that of salicylic acid and the salicylates. It is used extensively as an antipyretic and antirheumatic. It is an excellent headache remedy. It must be used with caution because some individuals are easily poisoned by it, due probably to an idiosyncrasy.

Average dose: 0.3 gm. or 5 grains.

Phenylis Salicylas, Phenyl Salicylate (Salol), U. S. P.—The phenyl ester $(C_6H_4(OH)(COOC_6H_5))$ of salicylic acid. Preserve it in well-closed containers in a cool place.

PROPERTIES: A white crystalline powder, having an aromatic odor and a characteristic taste. It is practically insoluble in water, soluble in six parts of alcohol, very soluble in chloroform, ether, or fixed or volatile oils.

PREPARATION: It is made by the action of dehydrating agents on a mixture of phenol and salicylic acid.

ACTION AND USES: It is used as an intestinal antiseptic. In the intestines it is decomposed into its component parts of phenol and salicylic acid, both of which exert their antiseptic action in the intestines. It is given with bismuth subnitrate for diarrhoea. It passes through the stomach unchanged, but breaks down in the intestines, and because of this property it is used for coating enteric pills, protecting them from the action of the stomach juices.

Average dose: 0.3 gm. or 5 grains.

Acidum Tannicum, Tannic Acid (Tannin, Gallotannic Acid), U. S. P.—A tannin usually obtained from nutgalls. Preserve it in well-closed containers in a cool place, protected from light.

PROPERTIES: It is a yellowish-white to light brown, amorphous powder, turning darker on exposure to light, nearly odorless, and having a strong astringent

taste. It is soluble in 1 part of glycerin, and is very soluble in water or alcohol.

ACTION AND USES: It is an astringent, and hæmostatic. It is used in the form of an ointment for the treatment of hæmorrhoids and in an aqueous solution as an astringent mouth wash and gargle. It is an alkaloidal precipitant and may be used as a chemical antidote in certain cases of alkaloidal poisoning.

Average dose: 0.5 gm. or 8 grains.

Acidum Tartaricum, Tartaric Acid, U. S. P.—A dibasic organic acid usually obtained from wine lees or argol. It contains not less than 99.5 per cent of $C_2H_2(OH)_2(COOH)_2$.

PROPERTIES: It occurs in colorless, translucent prisms, or as a white granular powder, odorless, and having an acid taste. It is soluble in 0.75 parts of water, 3.3 parts of alcohol, and almost insoluble in chloroform and ether.

PREPARATION: It is made from the deposit in wine casks, which is composed principally of acid potassium tartrate. This acid potassium tartrate is converted into normal calcium tartrate (insoluble) in order to remove other impurities, then the pure calcium tartrate is treated with sulphuric acid, forming calcium sulphate and tartaric acid. The calcium sulphate is precipitated and the tartaric acid remains insoluble, from which it is obtained by filtration and evaporation.

ACTION AND USES: It is used in the preparation of effervescent salts and drinks. It is contained in the white packet of a Seidlitz powder. Salts of tartaric acid are laxative (cream of tartar and Rochelle salt).

Average dose: 0.5 gm. or 8 grains. (Rarely given internally.)

Acidum Phenyleinchoninicum, Phenyleinchoninic Acid (Phenyl-quinoline-carboxylic acid), U. S. P.—An organic acid, phenyl-quinoline-carboxylic acid ($C_6H_5.C_6H_4N.COOH$).

PROPERTIES: It occurs in small colorless needles or as a white or yellowish-white micro-crystalline powder, odorless or having a slight odor resembling benzoic acid, and a bitter taste. It is permanent in the air. It is insoluble in cold water, but slightly soluble in hot water; slightly soluble in cold alcohol, but readily soluble in hot alcohol.

ACTION AND USES: This compound is sold under the trade name of atophan. It stimulates the kidneys to excrete more urine and has a selective action on the excretion of uric acid, which is increased in greater ratio than the increase in the amount of urine. Because of this selective action in increasing uric acid elimination it is used in the treatment of gout.

Average dose: 0.5 gms. or 8 grains.

Amylis Nitris, Amyl Nitrite, U. S. P.—A liquid containing not less than 80 per cent of $C_5H_{11}NO_2$. Preserve it in hermetically sealed glass bulbs or glass-stoppered vials, in a cool place, protected from light.

PROPERTIES: It is a clear, yellowish liquid, of a peculiar ethereal fruitlike odor and a pungent, aromatic taste. It is almost insoluble in water, but is miscible with alcohol or ether. It is very volatile even at low temperatures and is inflammable.

ACTION AND USES: Amyl nitrite, like other nitrites (glyceryl nitrite, etc.), is a vasodilator (dilates the blood vessels). Amyl nitrite is given by inhalation to relax spasms of blood vessels in angina pectoris, asthma, and other painful affections due to arterial spasm. It is supplied to the Navy in the form of glass pearls (ampules) containing five minims each. When it is to be administered the pearl is crushed in a handkerchief and the volatile amyl nitrite inhaled. Its action is almost instantaneous.

Average dose: 0.2 c. c. or 3 minims by inhalation.

Spiritus Ætheris Nitrosi, Spirit of Nitrous Ether (Sweet Spirit of Nitre), U. S. P.—An alcoholic solution of ethyl nitrite ($C_2H_5NO_2$) containing not less than 3.5 per cent nor more than 5 per cent of $C_2H_5NO_2$. Preserve it in small, well-stoppered, dark amber colored bottles, in a cool and dark place, remote from fire.

PROPERTIES: It is a clear, mobile, volatile, and inflammable liquid of a pale yellow or faintly greenish-yellow tint, having a fragrant, ethereal, and pungent odor, free from acidity, and a sharp, burning taste. When kept for a long time it acquires an acid reaction.

PREPARATION: See U. S. P.

ACTION AND USES: It is a diuretic and diaphoretic. It is one of the ingredients contained in Brown Mixture. It frequently is given with solution of ammonium acetate.

Average dose: 2 c. c. or 30 minims.

Benzylis Benzoas, Benzyl Benzoate, $C_6H_5COOC_6H_5$.—A colorless, oily liquid, having an unpleasant taste. Insoluble in water; freely soluble in alcohol.

PREPARATION: Made by distillation of balsam of peru, which contains about 60 per cent of benzyl benzoate.

ACTION AND USES: Acts as an antispasmodic to involuntary muscles. Used to relieve pains due to spasm in gall-stone colic and abdominal cramps. It also is used as a palliative in the treatment of whooping cough and asthma. Is administered in the form of an emulsion. The following directions for making the emulsion are given in the supply table: "To 78 c. c. of ethyl alcohol, in which 2 grams of soap has been dissolved, add 20 grams of the drug to make an emulsion. The dose of this emulsion is 1.5 to 2 c. c."

Volatile oils, volatile oil drugs, and preparations made from volatile drugs.

Volatile oils are a class of substances having in common the properties of being volatile; almost insoluble in water; most of them are lighter than water; soluble in ether and alcohol; having a highly characteristic odor, and possessing antiseptic properties. They do not leave a permanent stain on paper like that left by a fixed oil. Most of them are obtained from plants where they exist naturally or are formed when the plant is brought in contact with water. They vary greatly in their chemical composition. The following classes of chemical compounds are found in volatile oils: Hydrocarbons, alcohols, aldehydes, esters, ketones, phenols, and phenol derivatives, sulphur compounds, etc. All these classes are not found in any one oil but a volatile oil may contain one or more compounds belonging to one or more of the above classes. Oil of peppermint contains menthol which is an alcohol; oil of thyme contains thymol which is a phenol; oil of gaultheria contains methyl salicylate which is an ester, etc. The medicinal properties of the volatile oils vary greatly, due to the difference in their chemical composition.

Oleum Menthae Piperitæ, Oil of Peppermint (Peppermint Oil), U. S. P.—A volatile oil distilled from the flowering plant of *Mentha Piperita*, rectified by steam distillation, and yielding not less than 5 per cent of esters, calculated as menthyl acetate ($C_{10}H_{18}O_2$), and not less than 50 per cent of total menthol ($C_{10}H_{18}OH$), free and as esters. Preserve it in well-stoppered amber-colored bottles, in a cool place, protected from light.

PROPERTIES: It is a colorless liquid, having a strong odor of peppermint and a pungent taste, followed by a sensation of cold when air is drawn into the mouth (menthol). It is very slightly soluble in water, and is soluble in 4 parts of 70 per cent alcohol.

ACTION AND USES: It is used as a flavoring, and as an aromatic stimulant and carminative. It is contained in soda-mint tablets.

Average dose: 0.2 c. c. or 3 minims.

Menthol, Menthol, U. S. P.—A secondary alcohol ($C_{10}H_{18}OH$), obtained from oil of peppermint or other mint oils. Preserve it in well-closed containers in a cool place.

PROPERTIES: It occurs in colorless, acicular or prismatic crystals, having a strong odor and taste of peppermint. When tasted it produces a sensation of warmth followed by cold when air is drawn into the mouth. It is slightly soluble in water; very soluble in alcohol, chloroform, ether, or in petroleum benzin; freely soluble in liquid petrolatum, fixed or volatile oils. When triturated with about an equal weight of camphor, thymol, or hydrated chloral the mixture becomes liquid.

PREPARATION: It is made by placing oil of peppermint in a freezing mixture; when the temperature reaches -22° C. the menthol precipitates from the oil.

ACTION AND USES: Externally it is applied to the skin as a local anæsthetic and cooling application for the relief of superficial neuralgias. It is extensively used in nose and throat sprays. It is applied in solution or ointment for the relief of itching skin diseases.

Average dose: 0.06 gm. or 1 grain.

Spiritus Aurantii Compositus, Compound Spirit of Orange, U. S. P.—It contains oil of orange, oil of lemon, oil of coriander, oil of anise, and alcohol. It should be kept in completely filled, well-stoppered bottles in a cool dark place.

ACTION AND USES: It is used as a flavoring and in the preparation of aromatic elixir.

Oleum Caryophylli, Oil of Clove (Oil of Cloves, Clove Oil), U. S. P.—A volatile oil distilled from the flower-buds of *Eugenia Aromatica* and *Jambosa Caryophyllus*, and yielding not less than 82 per cent, by volume, of eugenol ($C_6H_3(OH)(OCH_3)C_3H_5$). Preserve it in well-stoppered, amber-colored bottles in a cool place, protected from light.

PROPERTIES: It is a colorless or pale yellow liquid, becoming darker and thicker by age and the exposure to air, having the odor and taste of clove. It is soluble in two parts of 70 per cent alcohol.

ACTION AND USES: Internally it acts as a stimulant and carminative. Externally it is employed as a local anæsthetic, parasiticide, and counterirritant. In dental practice it is used to stop toothache by applying it, on a piece of cotton, to a previously cleaned tooth cavity. In microscopy it is used to clear tissues for mounting.

Average dose: 0.2 c. c. or 3 minims. (When given internally it should be diluted with five times its volume of cottonseed oil.)

Eugenol, Eugenol, U. S. P.—An unsaturated, aromatic phenol, $C_6H_3(OH)(OCH_3)C_3H_5$, obtained from oil of clove and from other sources. Preserve it in well-closed containers, in a cool place, protected from light.

PROPERTIES: It is a colorless or pale yellow, thin liquid, having a strongly aromatic odor of clove, and a pungent and spicy taste. It becomes darker and thicker on exposure to air. It is soluble in 2 parts of 70 per cent alcohol; miscible in alcohol, chloroform, ether, or fixed oils.

ACTION AND USES: It is used in dental practice as a substitute for oil of clove.

Average dose: 0.2 c. c. or 3 minims.

Tinctura Cardamomi Composita, Compound Tincture of Cardamom, U. S. P.—It contains the aromatic, carminative principles from cardamom seed, saigon cin-

namon, and caraway. It is colored red with cochineal. The menstruum is dilute alcohol containing a little glycerin.

ACTION AND USES: It is used as a carminative and flavoring agent.

Average dose: 0.4 c. c. or 1 fluid dram.

Oleum Picis Liquidæ Rectificatum, Rectified Oil of Tar, U. S. P.—A rectified volatile oil distilled from tar.

PROPERTIES: It is a thick liquid having a reddish brown color and a strong empyreumatic odor and taste. It is soluble in alcohol and insoluble in water.

PREPARATION: It is made from wood tar by subjecting it to distillation and collecting that portion of the distillate which is lighter than water. It is a mixture of phenols, hydrocarbons, acetic acid, and oil of turpentine.

ACTION AND USES: It is given internally in the treatment of chronic bronchitis. It is administered in the form of an emulsion; externally it is used in the treatment of skin diseases in the form of an ointment.

Average dose: 0.2 c. c. or 3 minims.

Eucalyptol, Eucalyptol (Cineol), U. S. P.—An organic compound ($C_{10}H_{18}O$) obtained from the volatile oil of *Eucalyptus Globulus* and from other sources. Preserve it in well-closed containers, in a cool place protected from light.

PROPERTIES: It is a colorless, oily liquid, having a characteristic, aromatic and distinctly camphoraceous odor, and a pungent, spicy taste. It is very slightly soluble in water, miscible with alcohol, chloroform, ether, glacial acetic acid, or fixed or volatile oils.

ACTION AND USES: It is a stimulant expectorant, mild antiseptic, and anthelmintic. It is given in the treatment of chronic bronchitis and pulmonary tuberculosis. A mixture of 2 parts eucalyptol, 4 parts chloroform, and 45 parts of castor oil is used internally (given in two doses) in the treatment of uncinariasis (hookworm). Used locally in throat and nasal sprays and in the treatment of chronic skin diseases.

Average dose: 0.3 c. c. or 5 minims.

Fluidextractum Zingiberis, Fluidextract of Ginger, U. S. P.—Each c. c. of the fluidextract represents the medicinal activity of 1 gram of the air-dried and powdered drug (ginger). The active substances in ginger are a volatile oil and a substance called gingerol.

ACTION AND USES: It is used in the preparation of syrup of ginger. It acts as a warm, stimulating carminative when taken internally and is a valuable remedy in the treatment of abdominal cramps.

Average dose: 1.0 c. c. or 15 minims (diluted with water).

Camphora, Camphor, U. S. P.—A ketone ($C_{10}H_{16}O$) obtained from *Cinnamomum Camphora*. Preserve it in well-closed containers in a cool place.

PROPERTIES: It occurs as white, translucent masses or granules of a tough consistence, having a penetrating, characteristic odor and a pungent, aromatic taste. It is readily pulverizable in the presence of a little alcohol, ether, or chloroform. It is slightly soluble in water and freely soluble in alcohol, chloroform, ether, or in fixed or volatile oils.

PREPARATION: It is obtained by treating the branches and chipped wood of the camphor tree with steam. The camphor in the wood is volatilized by the hot steam and then condensed.

ACTION AND USES: It is a circulatory stimulant, mild antiseptic, slightly rubefacient, and carminative. As a circulatory stimulant it should be given hypodermically in sterilized oil. It is used as a mild antiseptic in nose and throat sprays, as a rubefacient in liniments, and as a carminative in diarrhœa mixtures (Squibb's diarrhœa mixture). The official preparations containing camphor are: Camphor water, belladonna liniment, camphor liniment, chloro-

form liniment, soap liniment, spirit of camphor, and camphorated tincture of opium.

Average doses: By mouth 0.2 gm. or 3 grains; by hypodermic 0.1 gm. or $1\frac{1}{2}$ grains.

Methylis Salicylas, *Methyl Salicylate* (*Oil of Teaberry*, *Oil of Wintergreen*, *Oil of Sweet Birch*), U. S. P.—It contains not less than 98 per cent of $C_6H_4(OH)COO.CH_3$. It is produced synthetically or is obtained by distillation from *Gaultheria procumbens* or from *Betula lenta*. The label must indicate whether the methyl salicylate has been made synthetically or distilled from either of the above-mentioned plants. Preserve it in well-stoppered amber-colored bottles in a cool place, protected from light.

PROPERTIES: It is a colorless, yellowish or reddish liquid, having the characteristic odor and taste of gaultheria. It is sparingly soluble in water, miscible with alcohol and glacial acetic acid, and is soluble in 6 parts of 70 per cent alcohol.

ACTION AND USES: It is antirheumatic and slightly antiseptic. Given internally its antirheumatic action is like that of the other salicylates. It is rapidly absorbed when rubbed on the skin or applied to the skin on a cloth. It is applied locally for the relief of rheumatic pains in the joints.

Average dose: 0.75 c. c. or 12 minims.

Thymol, *Thymol*, U. S. P.—A phenol $C_6H_3(CH_3)(OH)(C_3H_7)$ occurring in the volatile oil of *Thymus vulgaris* and in some other volatile oils. Preserve it in well-closed containers.

PROPERTIES: It occurs in large, colorless, translucent prisms, having an aromatic, thymelike odor and a pungent, aromatic taste, with a slight caustic effect upon the lips. It is soluble in 1,010 parts of water, 1 part of alcohol, 0.7 parts of chloroform, 1.5 parts of ether, 1.7 parts of olive oil, and in glacial acetic acid or in fixed or volatile oils. When triturated with about an equal weight of camphor or menthol, the mixture liquifies.

ACTION AND USES: Thymol is used as an anthelmintic and antiseptic. As an antiseptic it is employed in mouth washes, gargles, and sprays. As an anthelmintic it is given for the cure of hookworm disease. Oils should not be given while thymol is in the intestinal tract because they cause it to be absorbed, with resulting symptoms of poisoning. Its administration should be preceded and followed by administrations of magnesium sulphate.

Average dose: Antiseptic, 0.125 gm. or 2 grains; anthelmintic, 1 gm. or 15 grains.

Thymolis Iodidum, *Thymol Iodide* (*Aristol*), U. S. P.—(Chiefly dithymoldiiodide $(C_6H_2.CH_3.C_3H_7.OI)_2$. It contains, when dried to constant weight in a desiccator over sulphuric acid, not less than 43 per cent of iodine. Preserve it in well-closed containers, protected from light.

PROPERTIES: It is a reddish-brown, or reddish-yellow bulky powder with a very slight, aromatic odor. It is insoluble in water or glycerin; slightly soluble in alcohol and very soluble in chloroform, ether, or in fixed or volatile oils.

PREPARATION: It may be made by adding an aqueous solution of iodine and potassium iodide to an aqueous solution of sodium hydroxide and thymol with constant stirring. Thymol iodide is precipitated from this mixture.

ACTION AND USES: It is a valuable antiseptic dusting powder. It is used in surgery as a substitute for iodoform, and as an external application to ulcers and skin diseases, either in the form of dry powder or ointment. It commonly is known as aristol.

Emplastrum Sinapis, Mustard Plaster (Mustard Paper), U. S. P.—A uniform mixture of powdered black mustard (deprived of its fixed oil) and a solution of rubber, spread on paper, cotton cloth, or other fabric. It should be one square decimeter (16 square inches) in size and contain not less than 2.5 grams of black mustard deprived of its fixed oil.

PROPERTIES: When moistened thoroughly with tepid (not hot) water and applied to the skin, the plaster produces a decided warmth and reddening of the skin within five minutes. The irritating effect is produced by the volatile oil of mustard. This oil is liberated when mustard is mixed with water.

ACTION AND USES: It is an extensively used counterirritant. It is used for the relief of congestion and pain in the chest, abdomen, joints, or muscles.

Emplastrum Capsici, Capsicum Plaster, U. S. P.—It is composed of a mixture of oleoresin of capsicum and rubber plaster. Each 15 square centimeters of the spread plaster should contain 0.25 gm. of oleoresin of capsicum.

ACTION AND USES: It is used as a rubefacient.

Tinctura Capsici, Tincture of Capsicum, U. S. P.—It is a 10 per cent tincture, made by exhausting the active principles contained in cayenne pepper with alcohol. It has a light reddish color and the fiery taste of cayenne pepper.

ACTION AND USES: Taken internally it stimulates the secretions of the salivary, gastric, and intestinal glands. It is especially valuable in gastritis due to alcoholism.

Average dose: 0.5 c. c. or 8 minims.

Oleum Santali, Oil of Santal (Santalwood Oil, Oil of Sandalwood), U. S. P.—A volatile oil distilled from the wood of *Santalum album*, yielding not less than 90 per cent of alcohols, calculated as santalol ($C_{15}H_{26}O$). Preserve it in well-stoppered, amber-colored bottles in a cool place, protected from light.

PROPERTIES: It is a pale yellow, thick liquid; soluble in 5 parts of 70 per cent alcohol.

ACTION AND USES: It is given internally as a stimulant and disinfectant to the mucous membranes of the genito-urinary tract. In overdoses it is very irritating to the genito-urinary tract, and therefore should be given with care. Its principal use is in the treatment of chronic gonorrhœa.

Average dose: 0.5 c. c. or 8 minims (in capsules, three times a day).

Fluidextractum Buchu, Fluidextract of Buchu, U. S. P.—One c. c. of the fluid extract represents the medicinal activity of 1 gram of the air-dried and powdered drug (buchu). Buchu is the dried leaves of *Barosma betulina*, a small shrubby plant growing in Cape Colony. Its active principles are a volatile oil and a resin.

ACTION AND USES: Its activity depends upon the volatile oil, which is eliminated by the kidneys and acts as a tonic and disinfectant to the mucous membrane of the genito-urinary tract. It is used in the treatment of chronic inflammatory conditions of the bladder.

Average doses: 2 c. c. or 30 minims.

Fluidextractum Pruni Virginianæ, Fluidextract of Wild Cherry, N. F.—One c. c. of fluid extract of wild cherry contains the active medicinal virtues of 1 gram of air-dried and powdered wild cherry bark. Wild cherry is the stem bark of *Prunus serotina*, collected in autumn and carefully dried. The bark should be kept in well-closed containers, protected from light. The bark contains a glucoside, which in contact with water and under the influence of an enzyme present in the bark splits up into benzaldehyde (oil of bitter almond) and hydrocyanic acid, and these are the substances to which wild cherry owes its medicinal virtue.

ACTION AND USES: Fluid extract of wild cherry is used in making syrup of wild cherry, given internally as a sedative expectorant.

Average dose: 2 c. c. or 30 minims.

Resins, oleo-resins, gum-resins, balsams, and their preparations.

Resins generally are considered to be oxidation products of the terpene group of volatile oils, are complex in composition and apparently have as their chief constituents resin acids, resin esters, and resenes (of which but little is known). Those which are acid in character form resin soap when dissolved in alkalis. They are brittle, noncrystalline solids, fusible but not volatile, insoluble in water, soluble in alcohol, ether, chloroform, carbon disulphide, fixed or volatile oils, ammonia and fixed alkalis, and soften and melt at moderate temperature. They may be divided into three groups: True Resins (described above), Oleo-resins and Balsams, and Gum-resins.

Oleo-resins are natural mixtures or solutions of resins in volatile oils. Balsams are those liquid or soft products which contain benzoic and cinnamic acids, or an analogous acid, in addition to the resin: generally are spoken of as resinous or oleo-resinous exudates, and have the so-called balsamic odor.

Gum-resins are natural mixtures of gums (substances having a composition similar to starch) and resins, and are found as milky exudations from plants. When rubbed up with water, gum-resins form an emulsion, the gummy substance dissolving to form a mucilage which holds the resin in suspension.

Oleum Terebinthinae, *Oil of Turpentine* (*Spirits of Turpentine*), U. S. P.—The volatile oil distilled with water from the concrete oleo-resin obtained from *Pinus palustris* or from other species of *Pinus*. Preserve it in well-closed containers.

PROPERTIES: It is a colorless liquid having a characteristic odor and taste, both of which become stronger and less pleasant on aging or exposure to the air. Almost insoluble in water; soluble in 5 parts of alcohol, and freely soluble in oils.

ACTION AND USES: The rectified oil of turpentine, U. S. P., should be used internally and oil of turpentine externally. When given internally it acts as a diuretic, expectorant, and anthelmintic. Externally it is used as a counter-irritant and rubefacient.

Average dose: 0.3 c. c. or 5 minims (of the rectified oil).

Terebinnum, *Terebene*, U. S. P.—A liquid consisting of dipentene and other hydrocarbons, obtained by the action of concentrated sulphuric acid on oil of turpentine. Preserve it in well-closed containers, protected from light.

PROPERTIES: It is a colorless, thin liquid, having a thymelike odor and a terebinthinate taste. It is soluble in 3 parts of alcohol and slightly soluble in water. On exposure to light it becomes resinified and acquires an acid reaction.

ACTION AND USES: It is a stimulant to mucous membranes. It is given internally as a stimulating expectorant, especially in the treatment of chronic bronchitis. It is best given in capsules or on sugar.

Average dose: 0.25 c. c. or 4 minims.

Terpini Hydras, *Terpin Hydrate*, U. S. P.—The hydrate ($C_{10}H_{18}(OH)_2 + H_2O$) of the dihydric alcohol terpin. Preserve it in well-closed containers, in a cool place.

PROPERTIES: It is a colorless, lustrous, odorless powder, having a slight aromatic and bitter taste. It is soluble in 200 parts of water and in 13 parts of alcohol.

PREPARATION: It is made by the action of nitric acid on a mixture of alcohol and rectified oil of turpentine.

ACTION AND USES: It has a stimulating action upon mucous membranes. Its action is expectorant, diuretic, and slightly antiseptic. Its principal use is as an expectorant in the treatment of chronic bronchitis. It is administered in the form of an elixir.

Average dose: 0.25 gm. or 4 grains.

Tinctura Myrrhae, *Tincture of Myrrh*, U. S. P.—It is made by extracting (by maceration) the soluble principles from 200 grams of powdered myrrh with sufficient alcohol to obtain 1,000 c. c. of finished tincture.

PROPERTIES: It is a dark reddish-brown liquid, having the balsamic odor of myrrh, and a bitter, aromatic taste. When mixed with water the resin contained in the alcoholic solution is precipitated. Myrrh is a gum resin. It contains 3 per cent of an oxygenated volatile oil, a bitter principle, 30 per cent of gum, and 60 per cent of resin.

ACTION AND USES: It is an astringent. It is rarely used internally. It is principally used locally as a mouth wash, diluted with water in the proportion of about 1 to 20, in the treatment of stomatitis, spongy gums, sore throat, pytalism, etc.

Average dose: 1 c. c. or 15 minims.

Balsamum Peruvianum, *Balsam of Peru* (*Peru Balsam*), U. S. P.—A balsam obtained from *Toluifera Pereiræ*. It contains 60 per cent of benzyl benzoate and about 30 per cent of resin.

PROPERTIES: It is a viscid liquid of a dark-brown color having an agreeable, vanilla-like odor, and a bitter, acrid taste. It is almost insoluble in water, soluble in alcohol or chloroform, and partly soluble in ether.

ACTION AND USES: A 5 per cent solution in castor oil is used as a stimulating dressing for sluggish granulations and chronic indolent ulcers. It is a valuable parasiticide in ringworm, pediculosis (crab lice), and scabies; for this purpose it is used in the form of an ointment consisting of 20 parts balsam Peru, 50 parts cotton seed oil, and 100 parts of petrolatum. In the treatment of scabies it is used like sulphur ointment (hot bath before, etc.). There may be added to this ointment 10 per cent of sulphur to increase its efficiency in the treatment of scabies.

Tinctura Benzoini Composita, *Compound Tincture of Benzoin* (*Friar's Balsam*), U. S. P.—It is a dark-brown alcoholic liquid, made by extracting, by maceration, the alcohol-soluble principles from benzoin, 10 grams; aloes, 2 grams; storax, 8 grams; and balsam of tolu, 4 grams, with sufficient alcohol to make 100 c. c. of finished tincture.

ACTION AND USES: It is used in steam atomizers as an inhalant in the treatment of croupous affections of the throat and bronchi. If a steam atomizer is not available, the inhalations may be given by adding a teaspoonful of tincture to a glassful of boiling water and inhaling the vapor. It also is used as a protective for ulcers, fissures of the lips and anus, bedsores, cracked nipples, etc. It rarely is used internally.

Average dose: 2 c. c. or 30 minims.

Oleoresina Aspidii, *Oleoresin of Aspidium* (*Oleoresin of Male Fern*), U. S. P.—Made by extracting the ether soluble principles from *Aspidium* by percolation with a menstruum consisting of ether. After percolation the ether is evaporated off, leaving the oleoresin of aspidium. It should be preserved in well-stoppered bottles. On standing, there is deposited in the bottom of the bottle a granular crystalline substance which should be thoroughly mixed with the liquid portion before use.

ACTION AND USES: Used as a tæniacide (kills tapeworms). Castor oil or other fixed oils should not be given while oleoresin of aspidium is in the

intestinal tract, because they cause absorption of the oleoresin and thus may cause toxic symptoms.

Average dose: 2 gm. or 30 grains. Only one dose a day.

Fixed oils, fats, and soaps.

Fixed oils are so called because they leave a stain on paper or cloth that will not wash out, nor will it volatilize when subjected to mild heat. In this respect they differ from volatile oils. Solid substances that leave a similar stain are called fats. Fixed oils are found principally in the vegetable kingdom, and the fats are obtained from the animal kingdom. Fixed oils and fats are classed together because of the close chemical relationship that exists between them. They are composed principally of mixtures of glycerides of organic acids (esters). The principal acids that are combined with glyceryl (C_3H_5) radicles in these glycerides are: Oleic, palmitic, stearic, linoleic, and ricinoleic. The glycerides of these acids are liquids, except those of stearic and palmitic acids. Most fats and oils in common use are composed of glycerides of two or more of the above acids. The consistence of a fat or oil is governed by the proportion in which the solid and liquid glycerides are contained in it. Cottonseed oil is composed principally of glyceryl oleate (olein), while beef tallow, a solid, is composed principally of glyceryl stearate (stearin), etc. If the basic glyceryl (C_3H_5) radicle in a glyceride is displaced by an alkali metal, like sodium, sodium stearate, sodium oleate, or sodium palmitate (soaps) are formed according to the acid in the glyceride; the glyceryl (C_3H_5) radicle is set free to combine with hydroxyl (OH) groups that were attached to the sodium, forming glycerin. This reaction is known as saponification. Rancidity is a condition in fixed oils and fats due to decomposition of the glycerides under the influence of air (oxygen), heat, and albuminous matter, resulting in the liberation of the fatty acids and generation of volatile acids that have a distinct odor.

Oleum Gossypii Seminis, Cottonseed Oil, U. S. P.—A fixed oil obtained from seeds of cultivated varieties of *Gossypium herbaceum*, or other species of *Gossypium*. It is made by expression.

PROPERTIES: It is a pale yellow, oily liquid, odorless or nearly odorless, and having a bland taste. It is almost insoluble in water; slightly soluble in alcohol; and is miscible with ether, chloroform, and petroleum benzin. It is readily saponified by strong solutions of alkalies forming soap.

ACTION AND USES: It is used in the preparation of liniments. Cottonseed oil and its derivatives are used extensively as food products. It also is used in large quantities in the manufacture of soap.

Average dose: 8 c. c., or 2 fluid drams.

Oleum Ricini, Castor Oil, U. S. P.—A fixed oil obtained from the seeds of *Ricinus communis*. Preserve it in well-closed containers.

PROPERTIES: It is a pale-yellowish or almost colorless, transparent, viscid liquid, having a faint, mild odor and a bland, afterwards slightly acrid and generally nauseating taste. It is almost insoluble in water and is soluble in equal parts of alcohol and in one and one-half times its volume of liquid petrolatum.

ACTION AND USES: It is used extensively as a simple purgative. It increases the intestinal secretions and stimulates the peristaltic movements of the intestines. Its disagreeable taste may be disguised partially by administering it between a layer of peppermint water below and a layer of compound tincture of cardamon above the oil.

Average dose: 15 c. c., or 4 fluid drams.

Oleum Morrhuae, Cod Liver Oil (Oleum Jecoris Aselli), U. S. P.—A fixed oil obtained from the fresh livers of *Gadus morrhua* (codfish) and other species of *Gadus* (hake, haddock, etc.). Preserve it in a cool place in well-closed containers which have been thoroughly dried before filling.

PROPERTIES: It is a pale yellow, thin, oily liquid, having a peculiar, slightly fishy, but not rancid odor, and a fishy taste. It is almost insoluble in water; but is slightly soluble in alcohol.

PREPARATION: The oil is obtained from the fresh fish livers by boiling them with water and skimming off the separated oil.

ACTION AND USES: It is used as a tonic in the treatment of wasting diseases. The ease with which it is assimilated makes it an excellent food. Its beneficial and curative effects are due principally to the presence of a large amount of fat-soluble "A" vitamine.

Average dose: 10 c. c. or $2\frac{1}{2}$ fluid drams.

Oleum Theobromatis, Oil of Theobroma (Cacao Butter, Butter of Cocoa), U. S. P.—A concrete fixed oil obtained from the roasted seeds of *Theobroma Cacao*.

PROPERTIES: It is a yellowish-white solid, having a faint, agreeable odor, and a bland, chocolate-like taste. It is insoluble in water, slightly soluble in alcohol, and freely soluble in ether or chloroform. It melts between 30° and 35° C. (86° and 95° F).

ACTION AND USES: It is used as a vehicle in the preparation of suppositories because it melts slightly below the temperature of the body, sets free any medicinal substance incorporated with it, and allows the medicine to come in contact with the mucous membranes. It also is used in the preparation of skin food (ointmentlike preparation) and as a lubricant in massage. It is not given internally.

Adeps, Lard, U. S. P.—The purified internal fat of the abdomen of the hog. Preserve it in a cool place in well-closed containers which are impervious to fat. *Adeps benzoïnatus (benzoïnated lard)*, U. S. P., is a lard that has been treated with benzoïn to prevent it from turning rancid. In the preparation of benzoïnated lard for use in warm climates the Pharmacopœia directs that 50 grams of white wax be added to every 950 grams of lard in order to raise its melting point.

ACTION AND USES: Benzoïnated lard is used principally as an ointment base. It will permit the incorporation of from 10 to 20 per cent of its weight of water. Next to lanolin it is the best base to use in an ointment when it is desired that the active medicine in the ointment be absorbed through the skin.

Adeps Lanæ Hydrosus, Hydrous Wool Fat (Lanolin), U. S. P.—The purified fat of the wool of the sheep, combined with not less than 25 per cent nor more than 30 per cent of water. Preserve it in a cool place in well-closed containers which are impervious to fat.

PROPERTIES: It is a yellowish-white, or nearly white, ointment-like mass, having not more than a slight odor. It is insoluble in water, but it mixes with its own weight of water without losing its ointmentlike character.

ACTION AND USES: It is used principally as an ointment base. It will permit 100 per cent of its weight of water to be incorporated with it, which makes it an excellent base to use when a large volume of an aqueous liquid is to be incorporated into an ointment. It also possesses the property of allowing drugs incorporated with it to be rapidly absorbed through the skin. Unlike lard and most other animal fats it does not turn rancid.

Cera Alba, White Wax, U. S. P.—It is yellow wax which has been bleached.

PROPERTIES: It is a yellowish-white solid, somewhat translucent in thin layers, having a faint characteristic odor, practically tasteless, and is free from rancidity.

ACTION AND USES: It is used to stiffen ointments in warm climates, and it also is used in the preparation of cerates (stiff ointments). It is sometimes adulterated with paraffin.

Sapo, Soap, U. S. P.—Soap prepared from olive oil and sodium hydroxide. Preserve dried or powdered soap in well-closed containers.

PROPERTIES: It occurs as a white or whitish solid in the form of bars, hard, yet easily cut when fresh, or as a fine yellowish-white powder, having a faint, peculiar odor, free from rancidity, and a disagreeable alkaline taste. It is soluble in water and in alcohol.

ACTION AND USES: It is used as a pill excipient in the preparation of pills containing resinous drugs. It is used also in liniments and plasters.

Sapo Mollis, Soft Soap, U. S. P.—It is soap made by the action of potassium hydroxide on cottonseed oil.

PROPERTIES: It is a soft, unctuous, yellowish-white to brownish-yellow mass, having a slight characteristic odor and an alkaline taste. It is soluble in water and alcohol.

ACTION AND USES: It is used in the preparation of compound cresol solution and liniment of soft soap (tincture of green soap). Tincture of green soap is used extensively for surgical cleansing.

Linimentum Saponis, Soap Liniment, U. S. P.—Soap liniment is supplied to the Navy in powdered form consisting of soap, camphor, and oil of rosemary. The liniment is made from this powder by dissolving it in 70 per cent alcohol, allowing it to stand 24 hours and filtering.

ACTION AND USES: It is applied externally with massage as a rubefacient and also is used as a vehicle in the preparation of other more active liniments (chloroform liniment).

Amylaceous and mucilaginous substances.

Amylum, Starch, $C_6H_{10}O_5$ (*Cornstarch*), U. S. P.—The starch separated from the grain of *Zea Mays*.

PROPERTIES: It occurs in the form of a fine powder or irregular, angular, white masses, inodorous, and having a slight characteristic taste. It is insoluble in cold water or in alcohol. The individual grains are colored deep blue by iodine test solution. Cornstarch can be distinguished from other kinds of starch by the shape and size of the grain and the relative position of the hilum when viewed under a microscope. Boiled starch gives deeper blue reaction with iodine than raw starch.

ACTION AND USES: It is used externally in dusting powders; internally as a demulcent; and in the form of starch paste in water as a vehicle for the administration of drugs by rectum. *Starch paste is the best antidote for iodine poisoning.*

Acacia, Acacia (Gum Arabic), U. S. P.—The dried gummy exudation of *Acacia Senegal* and other African species of acacia.

PROPERTIES: It occurs in colorless or pale yellowish opaque, inodorous tears, which are completely soluble in water. These tears are reduced to a granular powder and supplied under the name granular acacia. Acacia is very sensitive to certain reagents. It is precipitated from aqueous solutions by alcohol, tincture of ferric chloride, solution of lead subacetate, and saturated solution of borax, and should not be prescribed with these substances.

ACTION AND USES: It is used as a demulcent and as an emulsifying agent; also as an excipient in pill making. Mucilages and syrups made with acacia do not keep well unless sterilized.

Sugar and saccharine substances.

Saccharum, Sugar (Sucrose), U. S. P.—Sucrose ($C_{12}H_{22}O_{11}$) is obtained from cultivated varieties of *Saccharum Officinarum* and from *Beta Vulgaris* and from other sources.

PROPERTIES: It occurs in white, hard, dry crystals, or as a white, crystalline powder, odorless, and having a sweet taste. It is permanent in the air. It is soluble in 0.5 parts of water, 170 parts of alcohol, and is insoluble in chloroform or ether. Its aqueous solution saturated at 25 C. has a specific gravity of about 1.340. Sucrose, by the action of ferments or dilute acids, is converted into invert sugar, which is composed of equal parts of levulose and dextrose, which are both fermentable.

ACTION AND USES: The most important use of sugar in medicine is in the preparation of sweet pharmaceutical preparations (syrups, elixirs, etc.). In the preparation of simple syrup it is important that a high grade of sugar be used and that a concentrated syrup be made. A concentrated syrup keeps better than one that is not concentrated. A supply of fresh syrup should not be mixed with an old syrup. It is better to throw away the old syrup and wash the bottle thoroughly with hot water before filling with newly made syrup.

Extractum Glycyrrhizæ Purum, Pure Extract of Glycyrrhiza, U. S. P.—The pure extract from the root of *Glycyrrhiza glabra typica*. It is made from the powdered root by extracting the soluble principles in the powder with weak ammonia water. It is a dark brown powder having a sweet taste.

ACTION AND USES: It is used internally as a demulcent and to disguise the disagreeable taste of other drugs. It is one of the ingredients in compound mixture of glycyrrhiza.

Mistura Glycyrrhizæ Composita, Compound Mixture of Glycyrrhiza (Brown Mixture), U. S. P.—Pure extract of glycyrrhiza, 30 grams (30 gm.); syrup, 50 cubic centimeters (50 c. c.); acacia, granulated, 30 grams (30 gm.); antimony and potassium tartrate, 240 milligrams (0.240 gm.); camphorated tincture of opium, 120 cubic centimeters (120 c. c.); spirit of nitrous ether, 30 cubic centimeters (30 c. c.); water, a sufficient quantity to make 1,000 cubic centimeters (1,000 c. c.).

Directions: Rub the pure extract of glycyrrhiza and acacia in a mortar with 500 c. c. of warm water until they are dissolved. Allow the solution to cool, transfer it to a graduated vessel, add the antimony and potassium tartrate, dissolved in 12 c. c. of hot water, then the other ingredients, and rinse the mortar with enough water to make the product measure 1,000 c. c. Mix the whole thoroughly.

Average dose: 10 c. c. or 2½ fluid drams.

Pulvis Glycyrrhizæ Compositus Powder, Compound Powder of Glycyrrhiza (Compound Licorice Powder), U. S. P.—It contains senna, glycyrrhiza, washed sulphur, oil of fennel, and sugar.

ACTION AND USES: It is used as a laxative and purgative. It is valuable in the treatment of constipation occurring in cases of hæmorrhoids.

Average dose: 4 gm. or 1 dram, administered with milk.

Glucosides, drugs containing glucosides and preparations made from glucosidal drugs.

Glucosides are substances existing in plants which under the influence of dilute acids or enzymes are decomposed (hydrolyzed) into a sugar (glucose) and one or more complex substances. The English names for the glucosides end

in *in*, as digitalin, strophanthin, amygdalin, salicin, etc. Medicinally, glucosides are very active bodies. They are difficult to isolate from the drugs containing them without splitting them up into something different. Glucosidal drugs are drugs that contain glucosides. Owing to the difficulty in extracting and isolating the glucosides contained in glucosidal drugs, they can not be assayed by chemical means. Biological assays (strength determined by testing the drug on an animal) have been provided for certain glucosidal drugs (digitalis, strophanthus, and squill).

Digitalis, Digitalis (Foxglove), U. S. P.—The carefully dried leaves of *Digitalis purpurea*, without the presence or admixture of more than 2 per cent of stems, flowers, or other foreign matter. If made into the official tincture and assayed biologically, the minimum lethal dose should not be greater than 0.006 c. c. of the tincture, or the equivalent in tincture of 0.0000005 gram of ouabain for each gram of body weight of a frog. *Digitalis* should be preserved in tightly closed containers, protected from light.

PROPERTIES: It contains a number of glucosidal principles, the most important of which are: Digitoxin, digitalin, and digitalein.

ACTION AND USES: It is a powerful heart stimulant, producing greater force of contraction of the heart muscles and reducing the number of beats per minute, with increased arterial pressure. Because of the increased arterial pressure, it acts as a powerful diuretic.

Average dose: 0.06 gram or 1 grain.

Tinctura Digitalis, Tincture of Digitalis, U. S. P.—If assayed biologically, the minimum lethal dose should not be greater than 0.006 c. c. of the tincture, or the equivalent in tincture of 0.0000005 gram of ouabain for each gram of body weight of a frog. It is a 10 per cent tincture.

ACTION AND USES: The use of the tincture is the same as the powder.

Average dose: 0.5 c. c. or 8 minims.

Strophanthus, Strophanthus, U. S. P.—The dried ripe seeds of *Strophanthus Kombé* or *Strophanthus hispidus*, deprived of the long awns. If made into the official tincture and assayed biologically, the minimum lethal dose should not be greater than 0.000006 c. c. of tincture, or the equivalent in tincture of 0.0000005 gram of ouabain for each gram of body weight of a frog. Preserve strophanthus in tightly closed containers, adding a few drops of chloroform or carbon tetrachloride from time to time to prevent attack by insects.

PROPERTIES: It contains a glucoside—strophanthin.

ACTION AND USES: See tincture of strophanthus, which is on the supply table.

Average dose: 0.06 gm. or 1 grain.

Tinctura Strophanthi, Tincture of Strophanthus, U. S. P.—If assayed biologically, the minimum lethal dose should not be greater than 0.000006 c. c. of tincture, or the equivalent in tincture of 0.0000005 gram of ouabain for each gram of body weight of a frog. It is a 10 per cent tincture. The active principle in this tincture is the glucoside strophanthin.

ACTION AND USES: It acts on the circulation like digitalis. It increases the force and volume of the heart beat but decreases its frequency. Like digitalis, it is a very poisonous drug and must be used with caution.

Average dose: 0.5 c. c. or 8 minims.

Santoninum, Santonin, U. S. P.—The inner anhydride or lactone of santonic acid obtained from *Artemisia pauciflora*. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs in colorless, shining, flattened rhombic prisms or as a crystalline powder; odorless and nearly tasteless at first, but afterwards developing a bitter taste; permanent in the air, but becomes yellow on exposure to light. It is very slightly soluble in water and soluble in 43 parts of alcohol.

ACTION AND USES: It is used principally as an anthelmintic for the removal from the intestines of *Ascaris lumbricoides* (round worms). It makes objects appear to the patient as if viewed through a yellow glass (xanthopsia).

Average dose: 0.06 gm. or 1 grain. (It is supplied to the Navy in one-half-grain tablets.

Tincture Gentianæ Composita, *Compound Tincture of Gentian*, U. S. P.—It contains in 1,000 c. c. the glycerin-hydro-alcoholic soluble principles from 100 grams gentian, the active principle of which is the glucoside gentiopierin, 40 grams bitter orange peel, and 10 grams of cardamon seed.

ACTION AND USES: It is used as a bitter tonic.

Average dose: 4 c. c. or 1 fluidram.

Vegetable drugs containing cathartic principles and their preparations.

Resina Scammonia, *Resin of Scammony*, U. S. P.—It is a resin obtained from scammony root. Scammony root is the dried root of *Convolvulus Scammonia*, yielding not less than 8 per cent of the total resins of scammony root.

ACTION AND USES: It is a drastic hydragogue cathartic. Neither scammony root nor resin of scammony are on the supply table, but the resin is contained in vegetable cathartic pills.

Average dose: 0.2 gm. or 3 grains. One cathartic pill contains one-tenth of a grain.

Resina Jalapæ, *Resin of Jalap*, U. S. P.—It is a resin obtained from Jalap, the dried tuberous root of *Erogonium Purga*, and yielding not less than 7 per cent of resin.

ACTION AND USES: It is a drastic purgative. It is one of the ingredients contained in vegetable cathartic pills.

Average dose: 0.125 gm. or 2 grains.

Resina Podophylli, *Resin of podophyllum*, U. S. P.—It is a resin obtained from the rhizome and root of *Podophyllum* (May Apple). *Podophyllum* is the dried rhizome and roots of *Podophyllum peltatum*, yielding not less than 3 per cent of resin.

ACTION AND USES: It is a cholagogue purgative. Resin of podophyllum is on the supply table in one-tenth-grain tablets. It also is contained in vegetable cathartic pills.

Average dose: 0.01 gm. or one-sixth grain.

Extractum Colocynthis, *Extract of Colocynth*, U. S. P.—It is an extract obtained from colocynth and is four times as strong as colocynth. Colocynth is the dried pulp of the fruit of *Citrullus Colocynthis* (bitter apple), and contains a purgative glucoside, colocynthin.

ACTION AND USES: It is a drastic purgative. It is contained in vegetable cathartic pills.

Average dose: 0.03 gm. or one-half grain. One cathartic pill contains about one-tenth of a grain.

Aloë, *Aloes*, U. S. P.—The inspissated juice of the leaves of *Aloë Perryi*, yielding Socotrine Aloes; or *Aloë vera*, yielding Curaçao Aloes; or *Aloë ferôx*, yielding Cape Aloes.

ACTION AND USES: It is used as a cathartic. It is one of the ingredients contained in vegetable cathartic pills. Aloin, one of the active principles of aloes, is contained in compound laxative pills, N. F.

Average dose: Aloes, 0.25 gm. or 4 grains; aloin, 0.015 gm. or one-fourth grain.

Extractum Leptandra, *Extract of Leptrandra* (*Culver's Root*), N. F.—It is an extract obtained from *Leptrandra*. One gram of extract represents 4 grams of *leptandra*. *Leptrandra* is the dried rhizomes and roots of *Veronica virginica*.

ACTION AND USES: It is used as a cathartic. It is contained in vegetable cathartic pills.

Average dose: 0.25 gm. or 4 grains.

Elaterium, *Elaterin*, U. S. P.—A neutral principle obtained from *Elaterium*, a substance deposited by the juice of *Ecballium Elaterium*, the "squirting cucumber."

ACTION AND USES: It is a cholagogue purgative. It is supplied to the Navy in the form of a trituration (the only official trituration) in tablets containing one-tenth grain each.

Fluidextractum Rhei, *Fluidextract of Rhubarb*, U. S. P.—Made by extracting the active principles of rhubarb with a menstruum consisting of 4 volumes of alcohol and 1 volume of water.

ACTION AND USES: Acts principally on the large intestines by producing frequent fluid stools accompanied by griping. The stools frequently are colored yellow with bile. On account of the rheotannic acid which it contains, rhubarb constipates after its purgative action. As a laxative it is particularly efficient in treating summer diarrhoeas of children, because after its purgative effect has been produced it checks the diarrhoea.

Average dose: 1 c. c. or 15 minims.

Extractum Cascarae Sagradae, *Extract of Cascara Sagrada*, U. S. P.—It is an extract obtained from *Cascara Sagrada*. One gram of extract represents 3 grams of *cascara sagrada*. *Cascara Sagrada* (Chittem or Sacred Bark) is the dried bark of the trunk and branches of *Rhamnus Purshiana*, the California Buckthorn. Unlike most extracts it is made by exhausting the drug with boiling water.

ACTION AND USES: It is a valuable laxative, acting mainly on the lower bowel. It is used in the treatment of chronic constipation. It is supplied to the Navy in tablet form.

Average dose: 0.25 gm. or 4 grains.

Fluidextractum Cascarae Sagradae Aromaticum, *Aromatic Fluidextract of Cascara Sagrada*, U. S. P.—Made by extracting the active principles of *cascara sagrada* with boiling water. The bitter taste is removed from the *cascara* by maceration and percolation while it is mixed with magnesium oxide. It is aromatized and sweetened with pure extract of glycyrrhiza, saccharin, oil of anise, oil of cinnamon, oil of coriander, and methyl salicylate. It contains about 25 per cent alcohol, 20 per cent glycerin, and 50 per cent water.

ACTION AND USES: It is preferred as a laxative over the other preparation of *cascara* because of its pleasant taste. It is used in making Elixir of *Cascara Sagrada*, N. F., and Compound Elixir of *Cascara Sagrada*, N. F.

Average dose: 2 c. c. or 30 minims.

Protein products obtained from animal substances and insects.

The proteins are complex organic substances containing the elements oxygen, hydrogen, carbon, and nitrogen; most of them contain sulphur; some, phosphorus and iron. They also may contain other elements; are found in plant and animal life, and easily undergo chemical changes when subjected to the influence of ferments or variations in temperature.

Pepsinum, *Pepsin*, U. S. P.—A mixture containing a proteolytic ferment or enzyme, obtained from the glandular layer of the fresh stomach of the hog. It digests not less than 3,000 times its own weight of freshly coagulated and disintegrated egg albumin. Pepsin of a higher digestive power may be brought to this standard by admixture with pepsin of a lower digestive strength or with sugar of milk. Preserve it in well closed containers.

PROPERTIES: It occurs in lustrous, white, pale yellow or yellowish, transparent or translucent scales, grains or spongy masses, or as a fine, white, or cream colored, amorphous powder; free from any offensive odor, and having a slightly acid or saline taste. It is not more than slightly hygroscopic. It is soluble in 50 parts of water and is nearly insoluble in alcohol. When in solution it is incompatible with alkalis, alkali earths, and alkali carbonates. The presence of more than 0.5 per cent of hydrochloric acid in pepsin solution retards its proteolytic activity.

ACTION AND USES: Pepsin is a normal constituent of the gastric juice, and, as indicated above, its function is to digest albuminous matter. It is given when there is a deficiency of pepsin in the gastric juice. There are a large number of National Formulary elixirs and liquids containing pepsin. *Pepsin and pancreatin never should be administered together; nor should pepsin be administered with sodium bicarbonate, which renders it inert.*

Average dose: 0.5 gm. or 8 grains.

Suprarenatum Siccum, Dried Suprarenals (*Desiccated Suprarenal Glands*), U. S. P.—The suprarenal glands of animals (sheep or ox) which are used by man for food, cleaned, dried, freed from fat, powdered, and containing not less than 0.4 per cent nor more than 0.6 per cent of epinephrine, the active principle of the suprarenal gland. One part of dried suprarenals represents approximately six parts of fresh gland, free from fat. If assayed biologically 1 gram of dried suprarenals contains the equivalent of 10 milligrams of lævomethyl-amino-ethanolcatechol (adrenalin).

PROPERTIES: It is a light-yellow powder, having a slight characteristic odor; partially soluble in water. The active substance contained in dried suprarenals is epinephrine (adrenalin). Epinephrine possesses properties resembling the alkaloids. It is basic in character (alkaline to litmus) and combines with acids to form salts (adrenalin chloride). Epinephrine also is prepared synthetically.

ACTION AND USES: The dried suprarenals are not supplied to the Navy, but a 1-1,000 solution of adrenalin chloride in normal salt solution is on the supply table. When solution of adrenalin chloride is administered hypodermically it raises the blood pressure (vaso-constriction) and acts as a heart stimulant. When applied locally to mucous membranes it contracts the small vessels, relieves congestion, and stops bleeding (hemostasis). Solution of adrenalin chloride is employed principally, mixed with solutions of local anæsthetics, in the proportion of 1 part of solution of adrenalin chloride to 20 parts of the anæsthetic solution (making an adrenalin strength of 1-20,000). It prevents the absorption of the anæsthetic (cocaine or procaine) by restricting the circulation, thereby confining the action of the anæsthetic to the area to which it is applied, intensifying its anæsthetic effect, and preventing its toxic effect on the system. Epinephrine is supplied for dental use in tablet form under the name *Suprarenin*, mixed with procaine (novocaine). Each tablet contains $\frac{1}{4}$ grain of procaine and $\frac{1}{1200}$ grain of L-suprarenin.

Liquor Hypophysis, Solution of Hypophysis (*Solution of the Pituitary Body*), U. S. P.—A solution containing the water-soluble principle, or principles from the fresh posterior lobe of the pituitary body of cattle. Extract the finely minced material with slightly acidulated water, boil the solution for 10 minutes and filter it. Sterilize this filtrate and preserve it in a sterile condition in glass containers.

ACTION AND USES: It is used as a heart stimulant in shock or collapse. It is used also in labor to increase the contractions of the uterus.

Average dose: 1 c. c. or 15 minims.

Cantharis, *Cantharides* (*Spanish Flies*, *Russian Flies*), U. S. P.—The dried beetles, *Cantharis vesicatoria*, yielding not less than 0.6 per cent of cantharidin. Preserve cantharides in tightly closed containers, adding a few drops of chloroform or carbon tetrachloride, from time to time, to prevent attack by insects.

ACTION AND USES: Cantharides owes its blistering properties to the active substance cantharidin. When given internally it is very irritating to the intestinal tract and is especially irritating to the genito-urinary organs during the elimination from the system. Externally it is used principally as a vesicant and counter-irritant and is supplied to the Navy in the form of a collodion.

Collodium Cantharidatum, *Cantharidal Collodion* (*Blistering Collodion*, *Vesicating Collodion*), U. S. P.—It is a yellowish-green liquid, having an ethereal odor. Made by treating cantharides with glacial acetic acid, acetone, and chloroform and subsequent evaporation of the solvents. The residue containing the active principles of cantharides (cantharidin) is dissolved in flexible collodion.

ACTION AND USES: It is used as a blistering agent by painting it on the skin.

Alkaloids, alkaloidal salts, and alkaloidal drugs.

Alkaloids are physiologically active principles found in the vegetable kingdom or produced synthetically and having a complex composition. They all contain N, C, and H, and the majority also contain O; most of those which do not being found as oily liquids. Because they contain nitrogen, are built on the ammonia type of bases, and act as derived ammonias in their method of forming salts, they frequently are spoken of as nitrogenous plant bases. They are derivatives principally of pyridine, quinoline, methane, or similar ringed bodies. The term alkaloid means like an alkali, with which substances, however, they must not be confused. Substances reacting to many of the alkaloidal tests are found in decayed animal tissue (probably produced in the process of decay) and are known as ptomaines or "cadaveric alkaloids." Alkaloids are regarded as decomposition products of proteins, nucleins, etc., in the plant cells during the process of growth, which have condensed with the substances present in plants.

In the vegetable kingdom their occurrence is confined to a few plant families as follows: Apocynaceæ, Leguminosæ, Liliaceæ, Loganiaceæ, Papaveraceæ, Ranunculaceæ, Rubiaceæ, Rutaceæ, Solanaceæ, and Umbelliferae. They exist in all parts of plants, usually in the form of salts, as tannates, malates, quinate, meconates, etc. They can be extracted from drugs containing them, and are the active principles of the drugs in which they reside.

Some alkaloids are solids (amides), and some are liquids (amines). They are alkaline in their reaction and resemble inorganic bases in their chemical behavior, especially ammonia, in that they combine directly with acids to form salts. Their basic properties vary in intensity; some are strongly alkaline, and others are very weak. They are nearly all poisonous and have a bitter taste. With a few exceptions they are insoluble in water, but are soluble in alcohol, ether, chloroform, and petroleum benzin. The solubility of their salts is the reverse, being soluble in water but insoluble or slightly soluble in alcohol and insoluble in chloroform, ether, and petroleum benzin. Most of them are precipitated in aqueous solution from their salts upon the addition of alkalis or agents having an alkaline reaction. The alkaloids are decomposed by strong reducing or oxidizing agents (reason for the use of potassium permanganate in morphine poisoning). They are precipitated from their aqueous solution by mercuric potassium iodide, gold chloride, picric acid, tannic acid, sodium hydroxide, potassium hydroxide, alkali carbonates, alkali salicylates, benzoates, iodides, and bromides.

They vary greatly in their action on the system; some are stimulants, while others are depressants, etc. Some of the most valuable remedies used in medicine, as well as most of the narcotic habit-forming drugs, belong to this class. It is important to differentiate between alkaloids, alkaloidal salts, and alkaloidal drugs. Alkaloids are the basic substances; morphine is an alkaloid. Alkaloidal salts are compounds (salts or esters) formed by the union of the basic alkaloid with an acid; morphine sulphate is an alkaloidal salt formed by the union of morphine with sulphuric acid. Alkaloidal drugs are drugs (parts of plants) containing alkaloids; opium is an alkaloidal drug because it contains the alkaloid morphine; cinchona is an alkaloidal drug because it contains the alkaloid quinine.

In order to distinguish alkaloids from glucosides a different terminology, which has been carried in the Pharmacopœial nomenclature, has been adopted for each class. The ending *ine* (Latin *ina*) is applied to alkaloids, and the ending *in* (Latin *inum*) is given to glucosides.

The following alkaloids and alkaloidal salts are official or on the supply table; those on the supply table appearing in italics: Morphine, *morphine sulphate*, codeine, *codeine sulphate*, codein phosphate, *apomorphine hydrochloride*, ethylmorphine hydrochloride, diacetyl morphine, *diacetylmorphine hydrochloride*, cotarnine hydrochloride, quinine, *quinine sulphate*, quinine bisulphate, *quinine hydrochloride*, quinine hydrobromide, *quinine chlor-hydrosulphate* (non-official), quinine salicylate, quinine tannate, quinine and uræa hydrochloride, cinchonine sulphate, cinchonidine sulphate, strychnine, strychnine nitrate, strychnine sulphate, physostigmine salicylate, *physostigmine sulphate* (non-official), atropine, *atropine sulphate*, *homatropine hydrobromide*, *scopolamine hydrobromide*, hyoscyamine hydrobromide, *pilocarpine hydrochloride*, pilocarpine nitrate, aconitine, hydrastine, hydrastinine hydrochloride, pelletierine tannate, *emetine hydrochloride*, cocaine, *cocaine hydrochloride*, betaeucaine hydrochloride, caffeine, *caffeine citrate*, *caffeine sodio-benzoate*, theobromine sodio-salicylate, sparteine sulphate, and colchicine.

The following alkaloidal drugs and preparations made from alkaloidal drugs are on the supply table: Powdered opium, tincture of opium, pill of opium and lead acetate, camphorated tincture of opium, powder of ipecac and opium, compound tincture of cinchona, tincture of nux vomica, fluid extract of ergot, extract of belladonna leaves, fluid extract of hyoscyamus, tincture of aconite, powdered ipecac, fluid extract of ipecac, belladonna plaster.

Opium, Opium, U. S. P.—The air-dried milky exudation obtained by incising the unripe capsules of *Papaver somniferum* and its variety *album*, and yielding in its normal, moist condition not less than 9.5 per cent of anhydrous morphine. This form of opium is not used medicinally nor is it on the supply table, but it is used in making powdered opium and granulated opium, and these two preparations of opium are used in making the other opium preparations.

Opii Pulvis, Powdered Opium, U. S. P.—Opium dried at a temperature not exceeding 70° C., reduced to a very fine powder, and yielding not less than 10 per cent nor more than 10.5 per cent of anhydrous morphine. Powdered opium of a higher morphine percentage may be brought within the required limits by admixture with powdered opium of a lower percentage, or with some inert diluent. Preserve it in well-closed containers.

PROPERTIES: It is a chocolate-colored powder, having a heavy narcotic odor and a bitter, characteristic taste.

CONSTITUENTS: Opium contains more than 20 different alkaloids, the most important of which are morphine and codeine.

ACTION AND USES: Opium and its preparation when given internally are depressant to the central nervous system, analgesic, and constipating. Opium has no local effect other than that produced after absorption. The effects produced by opium preparations are due principally to morphine. All the opium preparations, alkaloids obtained from opium, and derivatives of these alkaloids are subject to the restrictions imposed by the Harrison narcotic act. They are habit-forming drugs.

Average dose: 0.06 gm. or 1 grain.

Pulvis Ipecacuanhæ et Opii, Powder of Ipecac and Opium, (Dover's Powder), U. S. P.—It is made by mixing 10 per cent opium powder, 10 per cent ipecac powder, and 80 per cent sugar of milk. Ten grains of this powder contains 1 grain of powdered opium, 1 grain of powdered ipecac, and 8 grains of milk sugar.

ACTION AND USES: It is used as an analgesic and diaphoretic. It is on the supply table both in powder and tablet form.

Average dose: 0.05 gm. or 8 grains.

Tinctura Opii, Tincture of Opium (Laudanum), U. S. P.—One hundred c. c. of tincture of opium yields not less than 0.95 grams nor more than 1.05 grams of anhydrous morphine. It is made by extracting the active principles from granulated opium with dilute alcohol.

ACTION AND USES: It is a convenient form for the administration of opium. It is used in the preparation of lead and opium wash. It is given in diarrhœa for its sedative and constipating effect on the intestinal tract. It produces the characteristic effects of opium when given internally.

Average dose: 0.5 c. c. or 8 minims.

Tinctura Opii Camphorata, Camphorated Tincture of Opium (Paregoric), U. S. P.—It is made by extracting the active principles from powdered opium, 4 grams; benzoic acid, 4 grams; camphor, 4 grams; and oil of anise, 4 c. c., with a menstrum of dilute alcohol containing a little glycerin. It is the weakest and one of the most used of the opium preparations.

ACTION AND USES: It possesses analgesic and carminative properties. It is one of the ingredients in Brown Mixture (checks cough). It is used to relieve abdominal pain due to flatus (gas in the intestines), to check diarrhœa, etc.

Average dose: 4 c. c. or 1 fluidram.

Pilula Opii et Plumbi, Pill of Opium and Lead (N. F.).—Each pill contains 1 grain of lead acetate and 1 grain of opium.

ACTION AND USES: It combines the constipating effect of opium with the astringent effect of lead acetate. It is used in cases of persistent diarrhœa.

Average dose: 1 pill.

Morphinæ Sulphas, Morphine Sulphate, U. S. P.—The sulphate of the alkaloid morphine. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs in white, feathery, acicular, silky crystals, or in cubical masses; odorless, and permanent in the air. It is soluble in 15.5 parts of water and in 565 parts of alcohol.

ACTION AND USES: It is a powerful narcotic. It is depressant to the central nervous system, relieves pain, produces sleep, and tends to cause constipation. It is a dangerous habit-forming drug and should never be prescribed in repeated doses except by a doctor. *In case of acute poisoning by morphine, wash out the stomach with potassium permanganate solution and give stimulants.*

Average dose: 0.008 gm. or $\frac{1}{8}$ grain.

Codeina, Codeine (Methylmorphine), U. S. P.—An alkaloid obtained from opium, or prepared from morphine by methylation. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs in colorless, translucent, rhombic prisms or as a crystalline powder; odorless, and is slightly efflorescent in warm air. It is soluble in 120 parts of water and 2 parts of alcohol. Its aqueous solution is alkaline to litmus.

ACTION AND USES: It is sedative, analgesic, and hypnotic. Its action is somewhat like that of morphine but less intense. It is largely used as a sedative, in the treatment of coughs, to lessen the irritation of the respiratory tract.

Average dose: 0.03 gm. or $\frac{1}{2}$ grain.

Codeinæ Sulphas, Codeine Sulphate, U. S. P.—The sulphate of the alkaloid codeine. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs in long, glistening, white, needle-shaped crystals or rhombic prisms, or as a crystalline powder; odorless and efflorescent in the air. It is soluble in 30 parts of water and very slightly soluble in alcohol.

ACTION AND USES: Same as codeine.

Average dose: 0.03 gm. or $\frac{1}{2}$ grain.

Apomorphinæ Hydrochloridum, Apomorphine Hydrochloride, U. S. P.—The hydrochloride of an alkaloid prepared from morphine by the abstraction of one molecule of water. Preserve it, protected from light, in small, well-stoppered vials, which previously have been rinsed with diluted hydrochloric acid and dried. Apomorphine hydrochloride, if it imparts at once an emerald-green color to 100 parts of distilled water when shaken with it in a test tube, is unfit for use.

PROPERTIES: It occurs in minute white or grayish-white, glistening, monoclinic prisms; odorless, and acquiring a greenish tint upon exposure to light and air. It is soluble in 50 parts of water and in 50 parts of alcohol.

ACTION AND USES: It is emetic, expectorant, and depressant. Its principal use is as an emetic in cases where the stomach tube can not be passed or emetics can not be given by mouth. It is administered hypodermically.

Average dose: Emetic, hypodermic, 0.005 to 0.0065 gram or $\frac{1}{2}$ to $\frac{1}{10}$ grain. It is supplied to the Navy in $\frac{1}{20}$ grain hypodermic tablets.

Diacetylmorphinæ Hydrochloridum, Diacetylmorphine Hydrochloride, U. S. P.—The hydrochloride of the alkaloid diacetylmorphine (heroin). Preserve it in well-closed containers, protected from light.

PROPERTIES: It is a white, crystalline powder without odor. It is soluble in two parts of water; also soluble in alcohol.

ACTION AND USES: It is sedative and slightly analgesic. It is used as a cough sedative and frequently is prescribed in cough mixtures. It is a habit-forming drug and is falling into disuse because of this fact.

Average dose: 0.003 gram or $\frac{1}{20}$ grain.

Cinchona Rubra, Red Cinchona (Red Peruvian Bark), U. S. P.—The dried bark of *Cinchona succirubra*, or of its hybrids, yielding not less than 5 per cent of the alkaloids of red cinchona. The cinchona tree is grown along the Andes Mountains in South America. Cinchona is not on the supply table, but it is the source of quinine, and is used in making compound tincture of cinchona.

Tinctura Cinchonæ Composita, Compound Tincture of Cinchona, U. S. P.—One hundred mls of compound tincture of cinchona yields not less than 0.4 gram nor more than 0.5 gram of the alkaloids of cinchona.

PREPARATION: It is made by extracting the active principles from 100 grams of red cinchona; 80 grams bitter orange peel; and 20 grams of serpentaria with

a menstruum composed of alcohol, water, and glycerin and collecting 1,000 c. c. of percolate. See U. S. P.

ACTION AND USES: It is a valuable bitter tonic and antimalarial.

Average dose: 4 c. c. or 1 fluidram.

Quininæ Sulphas, Quinine Sulphate, U. S. P.—The sulphate of the alkaloid quinine. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs in white, silky, light, flexible, glistening crystals, making a very light and easily compressible mass; odorless and having a persistent, very bitter taste. It is soluble in 725 parts of water, 107 parts of alcohol, and 30 parts of glycerin. It is freely soluble in water to which has been added a small amount of mineral acid.

ACTION AND USES: It is *antimalarial*, antipyretic, and a bitter tonic. It is used principally in the treatment of malaria, for which it is specific. It should be noted that quinine sulphate is practically insoluble in water. If an aqueous solution is desired, it may be made by adding to the quinine sulphate mixed with the water in a graduate, dilute sulphuric or hydrochloric acid drop by drop until a solution is produced. An acid salt is formed in solution which is very soluble in water.

Average dose: Tonic, 0.1 gram or $1\frac{1}{2}$ grains; antimalarial, at least 1 gram or 15 grains daily.

Quininæ Hydrochloridum, Quinine Hydrochloride, U. S. P.—The hydrochloride of the alkaloid quinine. Preserve it in well-closed containers, protected from light.

PROPERTIES: It occurs in white, silky, glistening needles; odorless, and having a very bitter taste. It is soluble in 18 parts of water (more soluble than the sulphate), 0.8 part of alcohol, and in 7 parts of glycerin.

ACTION AND USES: The action and use of quinine hydrochloride is the same as the sulphate. It was added to the supply table for use in making elixir of iron, quinine, and strychnine, N. F. because it is more soluble than the sulphate.

Average dose: Tonic, 0.1 gram or $1\frac{1}{2}$ grains; antimalarial, 1 gram or 15 grains daily.

Quininæ Chlorhydrosulphas, Quinine Chlorhydrosulphate.—It is made by dissolving 10 parts of quinine sulphate in 3.3 parts of 25 per cent hydrochloric acid and allowing the solution to crystallize during spontaneous evaporation.

ACTION AND USES: It is supplied to the Navy in hypodermic tablets, containing 1 grain each, to be used for the hypodermic administration of quinine. This salt is selected for this purpose because it is more soluble than the other quinine salts, being soluble in 1 part of water.

Average dose: 0.06 gram or 1 grain.

Atropinæ Sulphas, Atropine Sulphate, U. S. P.—The sulphate of the alkaloid atropine.

PROPERTIES: It occurs as a white, crystalline powder or in microscopical needles and prisms; efflorescent in dry air; and odorless. *Great caution should be used in tasting it, and then only in very dilute solution.* It is soluble in 0.4 parts of water, and 5 parts of alcohol.

Average dose: 0.0005 gram or $1/120$ grain.

Emplastrum Belladonnæ, Belladonna Plaster, U. S. P.—An adhesive plaster containing 30 per cent of extract of belladonna leaves and yielding not less than 0.35 per cent nor more than 0.40 per cent of the alkaloids from belladonna leaves.

ACTION AND USES: It is applied to the skin to secure the local anodyne effect of belladonna. It is used for the relief of rheumatic and neuralgic pains.

Belladonna Folia, Belladonna Leaves (Deadly Nightshade Leaves) U. S. P.—The dried leaves and tops of *Atropa Belladonna*, without the presence or admixture of more than 10 per cent of its stems or other foreign matter, and yielding not less than 0.3 per cent of the total alkaloids of belladonna leaves. Belladonna leaves are not supplied to the Navy but they are used in making extract of belladonna and are the source of atropine. Belladonna leaves contain the mydriatic (pupil dilating) alkaloids of atropine, hyoscyamine, and belladonnine.

ACTION AND USES: See the Extract.

Average dose: 0.06 gram or 1 grain.

Extractum Belladonnae Foliorum, Extract of Belladonna Leaves, U. S. P.—Extract of belladonna leaves yields not less than 1.18 per cent nor more than 1.32 per cent of the alkaloids of belladonna leaves. One gram of the extract represents about 4 grams of belladonna leaves. It is dark green in color and of a pilular consistence. Extract of belladonna leaves may be used in making tincture of belladonna. It is used in making belladonna plaster, and belladonna ointment.

ACTION AND USES: It is used internally as an anodyne and antispasmodic. In large doses it produces dryness of the throat, dilates the pupils, diminishes the secretion of urine, causes difficulty in swallowing, and checks perspiration. It prevents griping of the intestines and is used in the compound laxative pill for this purpose. It is used locally in plasters, ointments, and suppositories for its anodyne effect.

Average dose: 0.015 gram or $\frac{1}{4}$ grain.

Physostigminæ Sulphas, Physostigmine Sulphate, Eserine Sulphate.—The sulphate of an alkaloid obtained from physostigma. Preserve it in small, sealed containers, protected from light.

PROPERTIES: It occurs in minute white crystals, becoming yellow on exposure to light and air. It is very deliquescent and readily soluble in water.

ACTION AND USE: It is a myotic, and is used in the treatment of eye diseases for the purpose of contracting the pupil. It may be used to hasten recovery from the effects of mydriatics. It is supplied to the Navy in sealed tubes containing 1 grain each, also in the form of hypodermic tablets containing 1/60 grain each.

Average dose: 0.001 gram or 1/60 grain.

Strychninæ Sulphas, Strychnine Sulphate, U. S. P.—The sulphate of the alkaloid strychnine. Preserve it in well-closed containers.

PROPERTIES: It occurs in colorless or white, prismatic crystals, or as a white crystalline powder; odorless, efflorescent in dry air, and having an intensely bitter taste. It is soluble in 32 parts of water, and 81 parts of alcohol. *Great caution must be used in tasting it, and then only in very dilute solutions.*

ACTION AND USES: It is a powerful stimulant directly to the spinal cord and indirectly to nearly all the organs of the body. It is a powerful neurotic poison, and must be administered cautiously. It is supplied to the Navy in the form of a powder in 1-gram bottles for use in making elixir of iron, quinine, and strychnine. It also is supplied in hypodermic tablets. One tablet contains 1/60 of a grain and another 1/30 of a grain. It is contained in the iron, quinine, arsenic, and strychnine tablet on the supply table. It is used as a respiratory and circulatory stimulant, is used also as a bitter tonic, and frequently is combined with iron and quinine in tonics, elixirs, and tablets.

Average dose: 0.0015 gram or 1/40 grain.

Tincture of Nucis Vomica, Tincture of Nux Vomica, U. S. P.—One hundred c. c. of tincture of nux vomica yields not less than 0.237 gram nor more than 0.263 gram of the alkaloids of nux vomica. It is approximately a 10 per cent tincture, but the exact strength is based on the assay.

ACTION AND USES: It possesses the stimulating and tonic properties of nux vomica. Because of its intensely bitter taste, it is used as a bitter tonic.

Average dose: 0.5 c. c. or 8 minims, which is equivalent to about 1/120 grain of strychnine.

Nux Vomica, Nux Vomica, U. S. P.—The dried ripe seeds of *Strychnos Nux-vomica*, yielding not less than 2.5 per cent of the alkaloids of nux vomica. *Strychnos nux-vomica* is an Asiatic plant. The alkaloids contained in nux-vomica are strychnine and brucine. It is not on the supply table, but is used in the preparation of tincture of nux vomica, and is contained in a tablet mixed with capsicum.

ACTION AND USES: The action of nux vomica is the same as that of strychnine, which is its most active principle. It is a direct stimulant to the spinal cord, and indirectly a stimulant to nearly all the organs of the body, thereby acting as a tonic. In large doses it is a poison, producing overstimulation and convulsions. Chloroform inhalations and chloral hydrate internally are given to relieve the convulsions.

Average dose: Tincture of nux-vomica, 0.5 c. c. or 8 minims.

Homatropinæ Hydrobromidum, Homatropine Hydrobromide, U. S. P.—The hydrobromide of homatropine, an alkaloid obtained by the condensation of tropine and mandelic acid. Preserve it in well-closed containers, protected from light. It is an artificial alkaloid (synthetic).

PROPERTIES: It occurs as a white, odorless, crystalline powder. *Great caution must be observed in tasting it, using only very dilute solutions.* Its solutions when locally applied dilate the pupil of the eye. It is soluble in 6 parts of water.

ACTION AND USES: The action of homatropine is nearly identical with that of atropine. A 1 per cent solution instilled into the eye produces dilatation of the pupil in less than an hour, and the effect wears off within 48 hours. This property gives it a decided advantage over atropine, which requires a longer time to dilate the pupil and a much longer time to recover from its effect. It is supplied to the Navy in small bottles containing 1 grain each.

Average dose: 0.0005 gram or 1/120 grain (seldom used internally).

Hyoscyamus, Hyoscyamus (Henbane), U. S. P.—The dried leaves and flowering or fruiting tops of *Hyoscyamus niger*, yielding not less than 0.065 per cent of the alkaloids of hyoscyamus. Hyoscyamus is not on the supply table but it is used in making the fluid extract of hyoscyamus, and it is one of the sources of scopolamine (hyoscine). The alkaloids contained in hyoscyamus are hyoscyamine and hyoscine (scopolamine).

ACTION AND USES: It is related closely to belladonna in its action, but is more sedative to the nervous system (due to the hyoscine which it contains). Hyoscyamus is supplied to the Navy in the form of a fluid extract, and its active principle hyoscine is supplied in hypodermic tablets under the name scopolamine hydrobromide.

Average dose: Tincture of hyoscyamus, 0.6 to 2 c. c. or 10 to 30 minims. (Seldom given in powder form.)

Fluidextractum Hyoscyamus, Fluidextract of Hyoscyamus (Fluidextract of Henbane), U. S. P.—One hundred c. c. of fluid extract of hyoscyamus yields not less than 0.055 nor more than 0.075 gram of the alkaloids of hyoscyamus.

ACTION AND USES: It is used as a hypnotic, nervous sedative, and analgesic. Given with purgatives it prevents griping effect.

Average dose: 0.2 c. c. or 3 minims.

Scopolaminæ Hydrobromidum, Scopolamine Hydrobromide (Hyosine Hydrobromide), U. S. P.—The hydrobromide of levorotatory scopolamine, also known as hyosine, obtained from various plants of the Solanaceæ. Preserve it in well-closed containers protected from the light.

PROPERTIES: It occurs in colorless, transparent, rhombic crystals, sometimes of large size, odorless, slightly efflorescent. *Great caution must be observed in tasting it and then only in very dilute solutions.* It is soluble in 1.5 parts of water.

ACTION AND USES: It is a powerful cerebral depressant and hypnotic. It is given to produce sleep, in cases of mania. It also is given with morphine as a preliminary to the use of ether anæsthesia. It is supplied to the Navy in hypodermic tablets containing 0.0003 gram or 1/200 grain, each.

Average dose: 0.0003 gram or 1/200 grain.

Pilocarpus, Pilocarpus (Jaborandi), U. S. P.—The dried leaflets of *Pilocarpus Jaborandi* yielding not less than 0.6 per cent of the alkaloids of pilocarpus. Pilocarpus is not on the supply table but it is the source from which pilocarpine is obtained. It contains a number of alkaloids, the most important of which is pilocarpine.

Pilocarpinæ Hydrochloridum, Pilocarpine Hydrochloride, U. S. P.—The hydrochloride of an alkaloid obtained from pilocarpus. Preserve it in well-closed containers protected from light.

PROPERTIES: It occurs in colorless, translucent crystals, odorless, and having a faintly bitter taste; hygroscopic on exposure to the air. It is soluble in 0.3 parts of water.

ACTION AND USES: It is used as a diaphoretic. It is supplied to the Navy in the form of hypodermic tablets containing $\frac{1}{2}$ grain each.

Average dose: 0.005 gram or $\frac{1}{2}$ grain (hypodermically).

Aconitum, Aconite (Monkshood), U. S. P.—The dried tuberous roots of *Aconitum Napellus*, yielding not less than 0.5 per cent of the ether-soluble alkaloids of aconite. If made into a fluid extract and assayed biologically the minimum lethal dose should not be greater than 0.00004 c. c. for each gram of body weight of guinea pig. Aconite is not on the supply table but is used in making tincture of aconite. Aconite contains the very active alkaloid aconitine.

Tinctura Aconiti, Tincture of Aconite, U. S. P.—One hundred c. c. of tincture yields not less than 0.045 gram nor more than 0.055 gram of the ether-soluble alkaloids of aconite. If assayed biologically the minimum lethal dose should not be greater than 0.0004 c. c. for each gram of body weight of guinea pig. It is approximately a 10 per cent tincture.

ACTION AND USES: Aconite slows the pulse and lowers the blood pressure. It is used internally as a circulatory depressant, diaphoretic, and antipyretic in fevers of short duration. It is a very poisonous tincture and must be administered cautiously.

Average dose: 0.3 c. c. or 5 minims.

Ipecacuanha, Ipecac, U. S. P.—The dried root of *Cephaelis ipecacuanha*, yielding not less than 1.75 per cent of the ether-soluble alkaloids of ipecac, dried and finely powdered. Ipecac contains several alkaloids, the most important of which is emetine.

ACTION AND USES: In large doses it acts as an emetic partly through its local irritant action. In small doses it stimulates the secretions of the

respiratory tract. Combined with opium (Dover's powder) it acts as a diaphoretic. It is specific against amœbic dysentery, given in the form of enteric pills (salol coated). It is used in the preparation of fluid extract of ipecac, and powder of ipecac and opium.

Average dose: Expectorant, 0.06 gram or 1 grain; emetic, 1.0 gram or 15 grains.

Fluidextractum Ipecacuanhæ, Fluidextract of Ipecac, U. S. P.—One hundred c. c. of fluid extract of ipecac yields not less than 1.8 grams nor more than 2.2 grams of the ether-soluble alkaloids of ipecac.

ACTION AND USE: The action and use of the fluid extract is the same as that of powered ipecac. The principal use of the fluid extract is in making the syrup of ipecac.

Average dose: Expectorant 0.05 c. c. or 1 minim; emetic, 1.0 c. c. or 15 minims.

Emetine Hydrochloridum, Emetine Hydrochloride, U. S. P.—The hydrochloride of the alkaloid emetine, obtained from ipecac. It contains variable amounts of water of crystallization. Preserve it in dark amber-colored vials protected from light.

PROPERTIES: It occurs as a white crystalline powder, without odor; darkens on exposure to the air; and is freely soluble in water.

ACTION AND USES: It is used in the treatment of pyorrhœa and amœbic dysentery, administered hypodermically. It is supplied to the Navy in the form of hypodermic tablets containing $\frac{1}{2}$ of a grain each.

Average dose: 0.02 gram or $\frac{1}{2}$ grain.

Coca, *Coca* (nonofficial).—The dried leaflets of *Erythroxylon Coca*, known commercially as *Huanuco Coca* or as *Trurillo Coca*, yielding not less than 0.5 per cent of the ether-soluble alkaloids of coca. It is cultivated in South America, Mexico, and the West Indies. Most of the coca leaves come from Peru, Bolivia, and Ecuador. It contains a number of alkaloids, the most important of which is cocaine. Coca leaves, its preparations, and derivatives, which includes cocaine, are restricted in their sale and use by the Harrison Narcotic Act. Coca leaves are not on the supply table nor are they recognized by the Pharmacopœia or National Formulary, and are of interest only as the source of cocaine.

Cocaina Hydrochloridum, Cocaine Hydrochloride, U. S. P.—The hydrochloride of the alkaloid cocaine.

PROPERTIES: It occurs in colorless, transparent, monoclinic prisms; in flaky, lustrous leaflets; or as a white crystalline powder; odorless and permanent in the air; soluble in 0.4 c. c. of water; soluble in glycerin and slightly so in alcohol. Cocaine solutions are decomposed by the heat of boiling water or in the presence of even slight traces of alkali.

ACTION AND USES: When applied locally, cocaine paralyzes the peripheral nerves, causing loss of sensation. When injected around a nerve sheath or into a nerve it produces anesthesia in the area supplied by the sensory fibers of that nerve. When absorbed into the system it first produces stimulation, followed by depression of the central nervous system. The principal use of cocaine is as a local anæsthetic. It can be used for deadening sensation in the eye when foreign bodies are to be removed. It is employed in solutions ranging from 1 to 5 per cent, made with distilled water. The absorption of cocaine is largely prevented by mixing 1 part of solution of adrenalin chloride with 20

parts of cocaine solution. Cocaine is a dangerous habit-forming drug and must be used cautiously to avoid starting the habit.

Average dose: 0.015 gm. or $\frac{1}{4}$ grain.

Procaina, Procaine (Novocaine).—The monohydrochloride of para-amino-benzoyl-diethyl-amino-ethanol. Procaine and novocaine are identical. A notation in the supply table states that procaine is manufactured in the United States under license issued by the Federal Trade Commission as the equivalent of "novocaine."

PROPERTIES: It occurs as fine, colorless needles and is soluble in an equal weight of water. It is precipitated from its aqueous solutions by alkali hydroxides and carbonates, but is not precipitated by sodium bicarbonate. The aqueous solution of procaine may be heated to boiling without decomposition, which is a decided advantage over cocaine, in that procaine may be thoroughly sterilized.

ACTION AND USES: It is used as a local anæsthetic, dissolved in distilled water, in strengths from 1 to 5 per cent. It has very little effect when applied externally to mucous membranes. When injected its action is similar to that of cocaine.

Caffeina Citrata, Citrated Caffeine, U. S. P.—Citrated caffeine contains, when dried to constant weight at 80° C., not less than 48 per cent of anhydrous caffeine.

PROPERTIES: It occurs as a white powder, odorless and having a slightly bitter, acid taste. It gives a clear syrupy solution with a small quantity of water, but caffeine precipitates on dilution. This precipitate redissolves on the further addition of water.

ACTION AND USES.—It is used as a cerebral and cardiac stimulant, and as a diuretic. It is contained in coffee and tea. It is supplied to the Navy in the form of 1 grain tablets, and in powder.

Average dose: 0.3 gm. or 5 grains.

Caffeina Sodio-Benzoeas, Caffeine Sodio-Benzoeate, U. S. P.—A mixture of caffeine and sodium benzoate. It contains, when dried to constant weight at 80° C., not less than 46 per cent nor more than 50 per cent of anhydrous caffeine; the remainder being sodium benzoate. Preserve it in well-closed containers.

PROPERTIES: It occurs as a white powder, is odorless, and has a slightly bitter taste. It is soluble in 1.1 parts of water.

ACTION AND USES: It is used for the same purposes that citrated caffeine is used for. It is preferred to caffeine citrate for hypodermic administration because it is more soluble in water. It is supplied to the Navy in hypodermic tablets containing 1 grain each.

Average dose: 0.2 gm. or 3 grains.

Ergota, Ergot (Ergot of Rye), U. S. P.—The carefully dried sclerotium of *Claviceps purpurea* replacing the grain of rye, *Secale cereale*, without the presence or admixture of more than 5 per cent of seeds, fruits or other foreign matter. Ergot is not on the supply table but is used in making the fluid extract of ergot.

Fluidextractum Ergotæ, Fluidextract of Ergot, U. S. P.

ACTION AND USES: It is a powerful vasoconstrictor. It is used as an echolic, producing contractions of the uterus. It also is used to control hæmorrhage.

Average dose: 2 c. c. or 30 minims.

CLASSIFICATION OF DRUGS ON THE SUPPLY TABLE ACCORDING TO THEIR THERAPEUTIC USE.

1. Drugs applied for their local action to the skin, wounds, or visible mucous membranes.

Corrosives or caustics.

Potassium hydroxide.
Silver nitrate.
Nitric acid.
Sulphuric acid.
Burnt alum.
Ammoniated mercury.
Phenol.
Sodium hydroxide.
Moulded silver nitrate.
Glacial acetic acid.

Disinfectants and antiseptics.

Solution of hydrogen dioxide.
Potassium permanganate.
Phenol.
Bichloride of mercury.
Calomel.
Silver nitrate.
Boric acid.
Iodine.
Iodoform.
Cresol.
Compound solution of cresol.
Solution of chlorinated soda.
Chlorasene.
Salicylic acid.
Thymol.
Eucalyptol.
Picric acid.
Tincture of iodine.
Solution of formaldehyde.
Sulphur.
Silver protein.
Colloidal silver.

Local anodynes and analgesics for pain and itching.

Potassium bicarbonate.
Cocaine hydrochloride.
Carbolic acid.
Atropine sulphate.
Tincture of aconite.
Eugenol.
Oil of clove.
Creosote.
Sodium bicarbonate.

Astringents.

Tannic acid.
Tincture of ferric chloride.
Bismuth subnitrate.
Lead acetate.
Zinc sulphate.
Zinc oxide.
Copper sulphate.
Alum.
Alcohol.
Bismuth subgallate.

Styptics.

Burnt alum.
Silver nitrate.
Moulded silver nitrate.

To contract vessels and reduce hemorrhage and swelling.

Solution of adrenalin chloride.

Emollients and protectives.

Benzoinated lard.
Petrolatum.
Liquid petrolatum.
Paraffin wax compound.
Lanolin.
White wax.
Cocoa butter.
Cottonseed oil.
Glycerite of boroglycerin.
Glycerite of starch.
Purified talcum.
Chalk.
Starch.
Zinc oxide.
Cataplasm of kaolin.

Local anæsthetics.

Ethyl chloride.
Cocaine hydrochloride.
Menthol.
Procaine.

2. Drugs used for affections of the alimentary tract.

MOUTH AND THROAT.

Demulcents.

Acacia.
 Starch.
 Pure extract of glycyrrhiza.
 Potassium chlorate.
 Ammonium chloride with cubeb and
 glycyrrhiza (tab.).
 Glycerin.

Astringents.

Tannic acid.
 Alum.
 Tincture of myrrh.

Antiseptics.

Boric acid.
 Thymol.
 Eucalyptol.

To lessen salivation.

Atropine sulphate.

Flavoring substances.

Sugar.
 Citric acid.
 Oil of peppermint.
 Methyl salicylate.

STOMACH.

Digestives.

Pepsin.
 Hydrochloric acid.

Emetics.

Sodium chloride.
 Apomorphine hydrochloride.
 Ipecac.
 Fluid extract of ipecac.
 Tartar emetic.
 Copper sulphate.
 Zinc sulphate.

To lessen irritation and vomiting.

Opium.
 Chloral hydrate.
 Potassium bromide.
 Sodium bromide.
 Lime water.
 Bismuth subnitrate.
 Demulcents.
 Cocaine hydrochloride.
 Codeine sulphate.
 Menthol.
 Morphine sulphate.

To lessen acidity, antacids.

Potassium bicarbonate.
 Sodium bicarbonate.

Magnesium carbonate.
 Milk of magnesia.
 Lime water.
 Prepared chalk.

To increase secretions, bitters.

Compound tincture of gentian.
 Tincture of nux vomica.
 Strychnine sulphate.
 Compound tincture of cinchona.
 Quinine sulphate.
 Quinine hydrochloride.

Carminatives.

Compound tincture of cardamom.
 Ether.
 Oil of peppermint.
 Tincture of capsicum.
 Fluid extract of ginger.
 Chloroform.
 Ammonium carbonate.
 Camphor.
 Oil of clove.
 Tincture of myrrh.
 Bismuth subgallate.
 Extract of belladonna.
 Fluid extract of hyoscyamus.

INTESTINES.

To promote evacuation—purgatives.

Sodium phosphate.
 Castor oil.
 Compound licorice powder.
 Vegetable cathartic pill.
 Compound laxative pill.
 Magnesium sulphate.
 Rochelle salt.
 Seidlitz powder.
 Solution of magnesium citrate.
 Liquid petrolatum.
 Calomel.
 Mass of mercury.
 Physostigmine sulphate.
 Resin of podophyllum.
 Cascara sagrada.
 Potassium bitartrate.

To destroy parasites—anthelmintics.

Santonin.
 Thymol.
 Chloroform.
 Oil of turpentine.
 Oleoresin of male fern.

Disinfectants and antiseptics.

Salol.
 Eucalyptol.

To lessen movement and relax spasm.

Powdered opium.
 Morphine sulphate.
 Lead acetate.
 Bismuth subnitrate.
 Tincture of opium.
 Tannic acid.
 Pill of lead and opium.
 Atropine sulphate.

3. Drugs used for their effect on the circulation.

HEART.

To strengthen contraction.

Tincture of digitalis.
 Tincture of strophanthus.
 Digitalin.

In auricular fibrillation.

Tincture of digitalis.
 Tincture of strophanthus.
 Digitalin.

To accelerate the pulse.

Atrophine sulphate.
 Caffeine citrate.
 Caffeine sodio-benzoas.
 Camphor.

To slow the pulse.

Tincture of digitalis.
 Tincture of strophanthus.
 Digitalin.
 Tincture of aconite.

VESSELS.

To contract caliber and raise blood pressure.

Tincture of digitalis.
 Tincture of strophanthus.
 Digitalin.
 Strychnine sulphate.
 Caffeine citrate.
 Fluidextract of ergot.

Solution of adrenalin chloride.
 Solution of hypophysis.

To relax blood vessels and lower blood pressure.

Amyl nitrite.
 Nitroglycerin.
 Spirit of nitrous ether.
 Purgatives.

To arrest internal hæmorrhage.

Powdered opium.
Tincture of opium.
Morphine sulphate.
Calcium chloride.

To remove fluid (dropsy).

Potassium acetate.
Spirit of nitrous ether.
Magnesium sulphate.
Calomel.
Vegetable cathartic pill.
Castor oil.

4. Drugs used for their effects on the genito-urinary system.

*To increase the flow of urine
(diuretics).*

Caffeine citrate.
Solution of hypophysis.
Potassium acetate.
Lithium citrate.
Calomel.
Spirit of nitrous ether.
Solution of ammonium acetate.

To render the urine less acid.

Potassium bicarbonate.
Sodium bicarbonate.
Potassium acetate.
Sodium citrate.

To make the urine more acid.

Dilute hydrochloric acid.

To render the urine antiseptic.

Aspirin.
Hexamethylnamine.
Salol.
Sodium salicylate.
Sodium borate.
Fluid extract of buchu.
Sodium benzoate.
Santal wood oil.
Salicylic acid.

To promote contractions of the uterus.

Fluid extract of ergot.
Quinine sulphate.
Solution of hypophysis.

5. Drugs used for their effects on the respiratory system.

To stimulate the respiratory center.

Atropine sulphate.
Caffeine sodio-benzoas.
Strychnine sulphate.
Oxygen.
Ammonia.
Aromatic spirit of ammonia.
Camphor.

*To reduce the irritability of the nerve
center in cough.*

Powdered opium.
Tincture of opium.
Morphine sulphate.
Codeine sulphate.
Heroin.
Chloral hydrate.
Sodium bromide.

*To increase and liquefy the bronchial
secretions.*

Powdered ipecac.
Fluid extract of ipecac.

Antimony and potassium tartrate.
Apomorphine hydrochloride.
Ammonium carbonate.
Potassium iodide.
Compound tincture of benzoin.
Ammonium chloride.
Cubeb.
Terpin hydrate.

To lessen the secretions of the bronchi.

Atropine sulphate.
Belladonna extract.

To relax bronchial spasm in asthma.

Amyl nitrite.
Extract of belladonna.
Atropine sulphate.
Solution of adrenalin chloride.
Potassium iodide.
Nitroglycerin.

Pulmonary disinfectants.

Creosote.
Guaiacol.
Creosote carbonate.
Rectified oil of tar.

6. Drugs used for their effects on the central nervous system.

STIMULANTS.

(a) *To the spinal cord.*
Strychnine sulphate.

(b) *To the brain and medulla oblongata.*

Caffeine citrate.
Caffeine sodio-benzoas.
Camphor.
Atropine sulphate.

DEPRESSANTS.

(a) *To paralyze sensation—general anæsthetics.*

Ether.
Chloroform.
Ethyl chloride.
Nitrous oxide.

(b) *To induce sleep and rest—hypnotics or narcotics.*

Powdered opium.
Morphine sulphate.
Codeine sulphate.
Scopolamine hydrobromide.
Sulphonethylmethanum.
Barbital.

(b) *To induce sleep and rest—hypnotics or narcotics—Continued.*

Chloral hydrate.
Potassium bromide.
Sodium bromide.
Chlorodyne tablets.

(c) *To relieve pain.*

Powdered opium.
Morphine sulphate.
Codeine sulphate.
Acetylsalicylic acid.
Acetanilid.
Phenacetine.
Antipyrine.

7. Drugs used to reduce fever temperature.

Acetylsalicylic acid.
Acetanilide.
Phenacetine.
Tincture of aconite.
Sodium salicylate.

Solution of ammonium acetate.
Guaiacol.
Ipecac.
Quinine sulphate.

8. Drugs used for their effect on the blood.

(a) *To increase the hæmoglobin:*

Tincture of ferric chloride.
Pill of ferrous carbonate.
Solution of iron and ammonium acetate.
Elixir of iron, quinine, and strychnine.
Solution of potassium arsenite.
Soluble ferric pyrophosphate.
Tincture of citro-chloride of iron.

(a) *To increase the hæmaglobin—Con.*
Tablets of iron, quinine, arsenic, and strychnine.

(b) *To render the blood alkaline:*

Potassium acetate.
Potassium bicarbonate.
Sodium bicarbonate.
Sodium carbonate.
Sodium citrate.

9. Drugs used for specific diseases.

In malaria.

Quinine sulphate.
Quinine hydrochloride.
Quinine chlor-hydrosulphate.
Solution of potassium arsenite.
Elixir of iron, quinine, and strychnine.

In syphilis.

Mercuric chloride.
Mercurous chloride.

In syphilis—Continued.

Mercurous iodide (pills) yellow.
Mercurial ointment.
Mercuric salicylate.
Oleate of mercury.
Potassium iodide.
Arsphenamine.
Neo-arsphenamine.

In diphtheria.

Antidiphtheritic serum.

In tetanus.

- Antitetanic serum.
- Chloral hydrate.

In cerebrospinal fever.

- Antimeningococcus serum.

In amœbic dysentery.

- Powdered ipecac.
- Emetine hydrochloride.

In rheumatic fever.

- Acetylsalicylic acid.
- Salicylic acid.

In rheumatic fever—Continued.

- Sodium salicylate.
- Methyl salicylate.
- Acidum phenylcinchoninicum.

In myxædema and some other thyroid diseases.

- Potassium iodide.

In trypanosomiasis.

- Antimony and potassium tartrate.

In gout.

- Acid phenylcinchoninicum.

10. Drugs used for their effect on the skin.

Irritants.

- Oil of turpentine.
- Mustard plaster.
- Capsicum plaster.
- Cantharidal collodion.
- Tincture of iodine.
- Ammonia.
- Liniment of soap.
- Liniment of chloroform.
- Tincture of aconite.

Disinfectant or irritant ointments in parasitic skin diseases.

- Mercurial ointment.
- Sulphur ointment.
- Tar ointment.
- Balsam of Peru ointment.
- Resorcinol ointment.
- Thymol ointment.

Disinfectant or irritant ointments in parasitic skin diseases—Continued.

- Ichthyol ointment.
- Salicylic acid ointment.
- Ammoniated mercury ointment.

Drugs administered internally to increase the secretions of perspiration (diaphoretics or sudorifics).

- Powdered ipecac.
- Powder of ipecac and opium.
- Pilocarpine hydrochloride.
- Antimony and potassium tartrate.
- Spirit of nitrous ether.

Drugs administered internally to lessen secretion of perspiration.

- Extract of belladonna.
- Atrophine sulphate.

12. Drugs used locally for their effects on the eye.

Drugs dilating the pupil and relaxing the accommodation—mydriatics.

- Atropine sulphate.
- Homatropine hydrobromide.
- Cocaine hydrochloride.

Drugs contracting the pupil of the eye—myotics.

- Pilocarpine hydrochloride.
- Physostigmine sulphate.

Antiseptics and astringents.

- Boric acid.
- Zinc sulphate.
- Colloidal silver.

Drugs used for the disinfection of rooms and inanimate objects.

- Chlorinated lime.
- Sulphur (sulphur dioxide).
- Solution of formaldehyde.
- Cresol.
- Bichloride of mercury.
- Barium dioxide (with solution of formaldehyde).
- Compound solution of cresol.

HARRISON NARCOTIC ACT.

The Harrison narcotic act (see chapter on Pharmacy) restricts the use of opium or coca leaves, their salts, derivatives, or preparations. The drugs and

preparations listed on the Supply Table of the Medical Department, United States Navy, which are subject to the restrictions set forth by this act are:

Opium.

Powdered opium.
 Pill of opium and lead acetate.
 Powder of opium and ipecac.
 Tincture of opium.
 Camphorated tincture of opium.
 Morphine sulphate.
 Codeine.

Codeine sulphate.
 Diacetylmorphine hydrochloride.
 Apomorphine hydrochloride.
 Chlorodyne tablets.

Coca leaves.

Cocaine hydrochloride.
 Procaine.

REFERENCES.

United States Pharmacopœia.
 Materia Medica, Pharmacology and Therapeutics.—Bastedo.
 Materia Medica and Therapeutics.—Potter.
 Pharmacology of Useful Drugs.—Hatcher-Wilbert.
 Materia Medica for Nurses.—Paul.
 Principles of Therapeutics.—Osborne.
 Useful Drugs.—American Medical Association.
 National Standard Dispensatory.—Hare, Caspari, Rusby.
 Pharmacology and Therapeutics.—Cushny.
 United States Dispensatory.—Remington and Wood.
 New and Non-Official Remedies.—American Medical Association.
 Materia Medica and Therapeutics.—Wilcox.
 Pharmaceutical and Medical Chemistry.—Sadler and Coblenz.
 Principles of Pharmacy.—Army.
 Practice of Pharmacy.—Remington.
 National Formulary.—American Pharmaceutical Association.

Drug Addiction.¹

Drug addiction may be defined as the habitual use of a drug or drugs for other than medicinal purposes.

A drug addict is an individual who has acquired the habit of taking drugs to satisfy a craving which has been developed and who, as a rule, is more or less uncomfortable when deprived of the drug over longer than the usual period.

The confirmed drug habitué, when he comes under the observation of the medical officer, as a rule has been taking the drug for a year or more and is well posted as to the source of supply, the amount of drug necessary to produce the desired effect in his particular case and the frequency with which he must repeat the dose.

There is a type of drug addict, however, who takes the drug more or less irregularly and who indulges in occasional "sprees" whenever he feels a desire or when some unusual situation arises in his life which he feels unable to face squarely. This type of addict not infrequently is met with in the early stages of his addiction and the longer he indulges the more he tends to become a confirmed habitué.

Drugs used by addicts.

Drugs used by addicts cover a great variety and include the so-called narcotics, the soporifics or hypnotics, and the drugs of the anæsthetic group.

Opium.—Probably the most striking example of the drug habit is the use of opium, its alkaloids and derivatives.

¹ Prepared by Lieut. Commander W. A. Bloedorn, Medical Corps, United States Navy.

The crude drug opium contains a number of alkaloids, of which the chief is morphine. The physiological action of opium is due principally to the morphine it contains. The effects of opium addiction, and the alkaloids of opium may be considered under the same heading.

Opium is taken either by smoking or swallowing, and in Oriental countries these methods are the usual means of ingestion. In this country and in most European countries morphine or heroin are the chief habit-forming drugs of the opium series.

The alkaloids of opium may be taken by hypodermic injection, by swallowing, or by snuffing up the nostrils.

The effect of opium and its derivatives, when taken in sufficient dosage, is sedative and the patient actually may go to sleep following its use. There is usually associated contraction of the pupils and an inhibitory effect on the activity of the glandular organs, as evidenced by dryness of the mouth and throat and the skin as well as constipation and digestive disturbances.

Cocaine.—The use of cocaine, though of comparatively recent date in this country, is an ancient practice in South America, where for generations it has been in vogue among the Indians.

Cocaine and its salts are absorbed freely and have a stimulating or excitant effect upon the central nervous system. In many cases they produce a temporary sense of exhilaration, with the disappearance of fatigue and a feeling of buoyancy. Large doses of the drug may stimulate to the point of excitement and there may be marked restlessness, tremors, and even convulsions, while, on the mental side, there may be incoherence, delirium, and persistent sleeplessness. A tolerance is developed rapidly.

Soporifics.—Among the soporifics must be mentioned chloral hydrate, paraldehyde, sulphonal, trional, and veronal. These drugs frequently are used for sleeplessness, and while they differ greatly in their tendency to form a habit, yet none of them are entirely free from this danger. The harm which results from the use of this class of drugs usually is due to their depressant action upon the heart and circulation, resulting occasionally in fainting or collapse. While it is true that these effects are comparatively infrequent and seem in many cases to depend upon individual susceptibility, they occur with sufficient frequency to urge caution in their use.

Anæsthetics.—Under this heading we may place chloroform, ether, and alcohol. The use of these drugs may result in habit formation. The effect of the alcohol habit is well known. It may manifest itself during periods of acute alcoholism by the well-known evidences of inebriety and in the cases of chronic alcoholism by mental impairment as well as physical deterioration.

Probably the use of chloroform and ether never will constitute a real source of danger in the naval service, as the habit does not appear to be widespread and the effects of continual use of these drugs are usually too noticeable to allow the patient to conceal the fact aboard ship or in a naval community.

The principal drugs, perhaps, which will be used among the naval personnel are opium and its derivatives, principally morphine and heroin, cocaine, and representatives of the soporific class, especially chloral hydrate or veronal.

Etiology.

The number of drug addicts existing in this country at present has been variously estimated at from 100,000 to 1,000,000. It is probably safe to say that the correct figure lies somewhere between these two extremes, and it is at once apparent that the problem of drug addiction is a serious one both from a sociologic and economic standpoint.

Both sexes are susceptible to drug addiction, although if we can judge from the numbers of those admitted to institutions for treatment, the number of male addicts exceeds the number of female addicts.

From the standpoint of intelligence and social standing, it may be said that no class of individuals is free from drug addiction. Every class of society is represented, from the denizen of the underworld to the so-called pillar of society.

The age at which drug addiction begins is particularly significant, and we find from examination of large numbers of addicts that from 20 to 30 per cent began the use of drugs while they were still minors.

The environment of the individual has a marked bearing on his tendency to drug addiction. Individuals who are associated with addicts and principally those who live in congested, overcrowded, and insanitary surroundings are particularly liable to contract the habit. The drug addict himself may be regarded as a focus of infection who through contact with susceptible individuals tends to spread the habit. There are two reasons for this attitude on the part of the addict: First is the desire for company, and, second, the financial gain derived from selling the drug to recruits.

While it is no doubt true that an appreciable number of addicts acquire the habit through the persistent use of drugs for the relief of pain or as the result of some disease, it is believed that this number constitutes a relatively small percentage of the total number of addicts.

Association with the drug and with individuals who are users of the drug is considered a potent and fertile source of addiction. These facts make it especially important that addicts in the Navy, either aboard ship or in the training stations, should be apprehended and eliminated from the service.

Symptoms.

It is a well-known fact that an addict will attempt to conceal the fact of his addiction by every conceivable means. One might think, at first glance, that these efforts on his part would be of no avail and that his predicament would be recognized easily by the medical officer as well as by his friends and associates. The mental picture which the average person has of the drug addict is an individual more or less emaciated, with sunken cheeks, sallow complexion, who nervously starts at the slightest sound, whose limbs and body show the marks of numerous needle punctures and who always carries in his pocket a hypodermic syringe and the necessary ammunition. While this picture may serve to identify the addict in some respects and particularly in the later stages of his addiction, it fails absolutely to identify the average drug addict.

If an addict is careful as to dosage and time and place of taking the drug, he may go along for years without his associates or even members of his immediate family being aware of the fact that he is an addict.

The symptoms and signs of drug addiction may be very meager and difficult to elicit and it requires the utmost skill to establish sufficient evidence to warrant a diagnosis of addiction.

There are two periods in the daily life of the addict during which he is particularly liable to detection and these periods are apt to become more frequent the longer he indulges.

The first period is that immediately following the administration of the drug and while the addict is getting the full physiological effect. If he has not been careful as to dosage he may take more than the usual amount, following which he will develop symptoms of an overdose of the particular drug in which

he indulges. If he is taking one of the narcotic or soporific drugs he may become drowsy or be found asleep at some unusual time or place when his predicament will be quite noticeable.

An overdose of cocaine frequently produces hyperexcitability, extreme nervousness; sometimes delirium and convulsions.

The second period during which symptoms may be noticeable is ushered in by a feeling of slight nervousness or uneasiness, which is a warning to the addict that it is time for another dose. If this period is prolonged, he begins to suffer more or less acutely with cramps and muscular pain, his nervousness increases, and he develops symptoms of sudden withdrawal of the drug. In the Navy this is a particularly important sign to look for, as men often may be taken away from the source of supply when leaving port or changing stations.

Diagnosis.

Close observation of an individual suspected of the drug habit over a sufficient period of time in most cases will establish or rule out the question of addiction. Changes in mood and bearing may be noted from time to time, as, for instance, when a quiet, reticent and possibly more or less morose individual leaves a group of men and then returns in a short time cheerful and in high spirits. It is possible that this change in his mental attitude may be due to the fact that he has taken some drug during his absence.

Again, following an overdose of the drug, the diagnosis may be easy and also deprivation of the drug may bring on more or less acute symptoms, depending on the stage of addiction and the individual may become nervous, uneasy, and definitely abnormal in his actions and mental attitude.

The small pupil, associated with opium or morphine addiction, is usually quite noticeable, while the mydriatic effect of cocaine, together with flushing of the face and the tendency to hyperexcitability, make the cocaine habitué liable to detection.

If an individual is a confirmed drug addict and it is possible to confine him or have him kept under constant watch, so that it is impossible for him to take the drug without being seen, he usually will develop symptoms of withdrawal of the drug after a variable period of from one to several days. In applying this test, however, it is essential that the patient be deprived of any outside cooperation in obtaining the drug and that he be separated from any of the drug which he may have in his possession. The addict under these circumstances is particularly ingenious and will devise innumerable schemes for keeping in contact with his reserve drug supply, so that the utmost care must be used in preventing drugs from reaching him.

The symptoms of withdrawal of the drug usually begin with a feeling of uneasiness and nervousness on the part of the patient. He may pace the deck, his features become drawn, and it becomes apparent that he is actually suffering. He may develop abdominal cramps or muscular cramps and may go into a condition of actual collapse.

However, if this test should prove negative, it is not an absolute indication that the patient is not an addict, as many individuals in the early stages of their addiction may take the drug only spasmodically or at irregular intervals and not suffer the acute symptoms of sudden withdrawal of the drug.

Probably the commonest and easiest way for the addict to indulge in drugs aboard ship, where the quarters are crowded and privacy is difficult to obtain, is by sniffing the drug up his nostrils. This method of administration requires no paraphernalia and leaves no particular mark upon the individual. It can be done quickly, easily, and effectively. The patient is able to gauge

with a fair degree of accuracy the amount of drug he needs, and most of the narcotic drugs lend themselves admirably to this practice.

A thorough physical examination may reveal no needle marks on the body of the individual, although it is possible that some hyperæmia or irritation of the nasal mucosa may be demonstrable.

At the present time heroin seems to be the drug in most common use, and in the absence of data pointing to any special drug it would be well to keep this particular drug in mind.

Treatment.

In the great majority of cases drug addicts in the naval service have contracted the habit before their entry into the service, and it is the usual practice once an addict has been identified to transfer him at once to a naval hospital and to terminate his service by medical survey. Any attempt to cure the patient of his addiction with an idea of restoring him to duty is considered unwise.

The usual treatment now employed in most institutions for the care of drug addicts is the gradual withdrawal of the drug. In other words, the patient is given each day a slightly less amount of the drug that he is taking until finally he is getting none of the drug. This method of treatment usually can be carried out even in cases of confirmed addiction with comparatively little suffering on the part of the patient, and it is a fairly easy matter to advance a drug addict to the point where he is taking no more of the drug. However, this does not indicate that the patient is cured of the drug habit, as probably the great majority of these cases, upon discharge from an institution, eventually drift back into their old habits. This is particularly true if the individual, upon discharge from the institution, returns to his old haunts and associates, where the drug immediately is available and where he even may obtain it without cost for the time being.

It is not considered advisable to attempt the cure of the drug habitué in the Navy with the object of restoring him to a duty status, and the patient in whom the fact of drug addiction has been definitely established is considered undesirable for the naval service.

CHAPTER IX.

TOXICOLOGY.¹

Toxicology is that branch of medical science which treats of the nature, effects, detection, properties, and antidotes of poisons.

A *poison* is a substance which, when absorbed into the body fluids of an ordinarily healthy organism, is capable of producing death or seriously affecting health.

The effects of poisons may be local or remote. By local effect is meant the direct action on the part to which the poison is applied, such as corrosion and irritation. By remote effect is meant the action of the poison on some organ remote from the seat of application. Some have both a local and remote effect, and sometimes a poison shows no effect, or only a slight one, until several doses have been taken, when suddenly an effect is produced nearly equal to that to be expected if the whole amount had been taken at once. This is known as cumulative effect.

There are several conditions of the individual which modify the effect of poisons, the principal ones being (1) age (young children generally are more susceptible to poisons than adults), (2) idiosyncrasy (some persons show an unusual sensitiveness to certain poisons), (3) tolerance (some persons have a natural tolerance for certain poisons which is not the result of habitual use), (4) habit (most persons by habitual use finally may become so accustomed to the effects that poisoning does not result from the taking of large doses), and (5) disease (some diseases increase and others lessen the action of poisons). Poisoning may be either acute or chronic. *Acute poisoning* is the condition brought on by the individual taking one overdose of poison. *Chronic poisoning* is the condition brought on by the individual taking repeated doses of a poison or as the result of the absorption of the poison over a long period of time. Matchmakers, barometer and thermometer makers, painters, and wall paperers are some of the classes of people subject to chronic poisoning from phosphorus, mercury, lead, and arsenic, respectively.

For the convenience of study the following general classification of poisons according to the chief effects produced is given:

Corrosives.—Substances which by contact rapidly destroy or decompose the body tissues. Examples: Hydrochloric, nitric, and sulphuric acids in concentrated form, oxalic acid, phenol, strong alkalies and their carbonates.

Irritants.—Agents that do not directly destroy the tissues but set up an inflammatory process at the seat of application. Examples: Potassium nitrate, zinc chloride, zinc sulphate, ferrous sulphate, silver nitrate, arsenic, iodine, and phosphorus.

Neurotics.—Poisons which act on the brain, spinal cord, and the general nervous system. Examples: Opium, prussic acid, ether, chloroform, aconite, nux vomica, belladonna, ethyl and methyl alcohols.

¹ Prepared by the faculty of the United States Naval Hospital Corps Training School, San Francisco, Calif., and reviewed by Chief Pharmacist C. Schaffer, United States Navy.

In addition to this classification, which is probably the one most commonly met with, a more modern and scientific one is as follows: (1) Inorganic poisons, (2) gaseous poisons, (3) alkaloidal poisons, (4) nonalkaloidal organic poisons, and (5) food poisons. Only two of these will be discussed in this chapter, which are:

Gaseous poisons.—Gases which when inhaled form chemical compounds with the hæmoglobin of the blood and destroy its capability as a carrier of oxygen. Examples: Hydrochloric-acid gas, sulphuric-acid gas, nitrous vapors, ammonia gas, carbonic-acid gas, carbon-monoxide gas, bromine, and the vapors of anesthetics.

Food poisons.—These may be poisonous metallic or organic substances introduced by carelessness, accident, or intention into wholesome food; poisonous substances naturally present in the vegetable or animal tissues used as food; pathogenic bacteria in the food, or poisonous substances produced in food by the changes resulting from the action of bacteria. Examples of each of the above classes are: Arsenic, lead, tin, zinc, and copper introduced from containers, soldering, chemical action, and for purposes of adulteration; the poisons found in mushrooms, sometimes in rhubarb, and ordinarily edible roots and tubers, certain species of fish and the flesh and roe of some fish during the spawning season; the causative agents of diphtheria, tuberculosis, scarlet fever, and typhoid fever in milk, of typhoid fever in or upon bread, sausage, oysters, and other foods, of botulism in or upon uncooked sausages, ripe olives, and other fruits and vegetables, and the ingestion of meat containing encysted worms or the larvæ of worms; and the poisons resulting from the decay or decomposition of food substances and which commonly are known as ptomaines.

The general symptoms of poisoning by poisons of any of the classes above are given immediately below. In addition to these the symptoms of individual poisons appear in the table describing those poisons.

Corrosives.—Immediately there is an acid, caustic burning pain in the mouth, with severe burning pain in the œsophagus and stomach. This is followed by retching and vomiting of the stomach contents mixed with dark-colored liquid and shreds of mucous membrane from the mouth, œsophagus, and stomach; the inside of the mouth is corroded and the lips present the characteristic stain if an acid has been used. Swallowing is very difficult; respiration is impeded; the abdomen is tender and distended with gas; the temperature is high; and the countenance is expressive of anxiety and great suffering.

Irritants.—Nausea, vomiting, and purging (frequently the vomited matter and stools contain blood); pain and cramps in the abdomen. In some cases there is inflammation of the urinary tract.

Neurotics.—As it is a difficult matter to give general symptoms of this class of poisons, they are here classified under—

(a) Depressants which are characterized by a period of exhilaration followed by drowsiness and stupor; slow and stertorous breathing; cold, clammy skin; livid countenance, slow pulse, muscular relaxation; dilated or contracted pupils, insensibility to external impressions, and

(b) Excitants. Characterized by rapid and feeble pulse; delirium, hot and dry skin; a sense of suffocation and inability to breathe; shuddering, and jerking of muscles; dilated or contracted pupils; disordered vision; sometimes convulsions and tetanus (as in the case of strychnine poisoning).

Gaseous poisoning.—Irritation and corrosion of the respiratory tract, with resultant bronchitis (either mild or severe); irritation of the eyes, mouth, stomach, and kidneys.

Food poisoning.—Gastrointestinal distress, nausea, vomiting, diarrhœa, urticaria, circulatory and nervous disturbances are the general symptoms of food poisoning and they may vary from mild discomfort to violent disturbance of the normal body functions.

The *treatment* of poisoning consists of (1) removal of the poisonous substance from the stomach, (2) administration of antidotes, (3) elimination of the poison from the circulation, and (4) neutralization of the systemic effects of the poison. Only the first two parts of the treatment will be discussed here, the other two being particularly within the province of the medical officer.

Removal of the poison from the stomach may be accomplished by the use of emetics, agents used to produce vomiting, and washing out of the stomach with a stomach tube.

There are two kinds of emetics: (*a*) Local, which act by irritating the ends of the gastric, œsophageal, and pharyngeal nerves, and (*b*) systemic, which act on the vomiting center in the medulla through the medium of the circulation.

Commonly used emetics are powdered ipecac, 30 grains; ground mustard, 2½ drams; tartar emetic, ½ to 1 grain; zinc sulphate, 10 to 20 grains; copper sulphate, 5 to 7½ grains; fluid extract of ipecac, 15 to 30 minims; tepid water, large quantity; alum, 60 grains to 8 fluid ounces of water; use of index finger; apomorphine hydrochloride (hypodermically), $\frac{1}{15}$ to $\frac{1}{3}$ grain.

Antidotes are agents which counteract the effects of a poison, and are classified as: (*a*) Chemical antidotes, which combine directly with the poisons and render them inert or harmless or produce a more insoluble compound and thus delay the absorption of poisons, and (*b*) physiological antidotes, which counteract the effects of poisons on the system.

The duties of an attendant in a case of poisoning are:

1. To prolong the life of the individual if possible.
2. To quickly get the bulk of the poison out of the stomach.
3. To antidote the remainder of the poison left in the stomach.
4. To eliminate from the system that portion of the poison which has been absorbed.
5. To treat the symptoms as they arise.
6. To take possession of all foods, medicines, vomited matter, feces, urine, and anything that may be of value in determining whether the poison was taken accidentally or intentionally, or whether criminally administered.

TABLE OF POISONS, SYMPTOMS AND TREATMENT.

Aconite. (Neurotic.)

SYMPTOMS: Anxious countenance; cold clammy skin; perspiration; great muscular weakness; dim sight; shallow, irregular and labored breathing; anæsthesia in a general way all over the body; and death from paralysis of the heart and respiration.

TREATMENT: Place the patient in a recumbent position; administer some form of tannin, preferably tea, or strong coffee, or potassium permanganate (20 grains to the pint of water) as a chemical antidote. Apply heat to the extremities; use stomach tube to empty the stomach; administer such stimulants as brandy or aromatic spirit of ammonia. Physiological antagonists are caffeine, atropine, morphine, ether, ammonia, and amyl nitrate.

Alcohol, ethyl. (Neurotic.)

SYMPTOMS: Exhilaration, staggering gait, deep sleep with stertorous breathing, acute gastritis and profound depression. Delirium tremens frequently occurs after an alcoholic debauch.

TREATMENT: Emetics or the use of the lavage tube, purgatives, proper diet, external heat.

The morbid conditions with which acute alcoholism may be confounded are: Apoplexy, opium narcosis, concussion of the brain, uræmia, epilepsy, and even acute pneumonia. The differential diagnosis is difficult to make in a state of deep coma. The pupils in alcoholism may be either dilated or contracted.

Alcohol, methyl. (Neurotic.)

SYMPTOMS: Primary, dizziness, perhaps nausea and vomiting, some disturbance of vision, with befogging of the brain; later, widely dilated pupils with perhaps blindness, weakened circulation, coma and death.

TREATMENT: Immediate evacuation of the stomach by means of a stomach tube followed by washing the stomach with a very dilute potassium permanganate solution, then warm water; administer two or three ounces of a solution of magnesium sulphate (Epsom salts) before removing the stomach tube; administer stimulants; apply external heat. It is beneficial at times to do a venesection, remove a quantity of blood and administer physiological saline solution intravenously. (This should be done by medical officers only.) Stupor from wood alcohol poisoning is treated by introducing into the system large doses of sodium bicarbonate and sodium citrate solutions, either by mouth or by rectum.

Arsenic. (Irritant.)

SYMPTOMS: Faintness and depression come on in about one-half hour; intense pain in the region of the stomach; tenderness of abdomen on slight pressure, nausea and vomiting increase by every act of swallowing; purging, bloody stools; cold, clammy skin; feeble pulse.

TREATMENT: Emetics; wash out stomach. Then follow with a wineglassful of recently prepared ferric hydroxide with magnesium oxide, but reliance must be placed on copious gastric lavage frequently repeated as the poison is not freely soluble. Warmth to extremities.

Physiological antagonists to combat collapse are caffeine and digitalis.

Atropine. (Neurotic.)

SYMPTOMS: Redness or rash of the skin; nose, mouth, throat and bronchi become dry; voice becomes hoarse; swallowing difficult; heart action rapid; pupils dilated; vision disordered; predisposition to laugh and talk loudly. There may be wild and maniacal delirium; and mental depression; suppression of the urine; convulsions; death occurs usually from asphyxia.

TREATMENT: Wash out stomach with a solution of potassium permanganate (20 grains to 1 pint of water); if not available give strong tea and an emetic. Apply an ice cap to the head; stimulate with strong coffee and eliminate the poison absorbed by the use of cathartics and diuretics.

Physiological antagonists are morphine (cautiously administered), ether to control spasms, and caffeine for its effect on the heart and brain; pilocarpine,

Belladonna. (Neurotic.)

SYMPTOMS: Same as atropine.

TREATMENT: Same as atropine.

Bichloride of mercury. (Corrosive.)

SYMPTOMS: Burning pain in mouth, throat, and abdomen; metallic taste in mouth; face flushed; abdomen tender; vomiting; bloody stools; tongue and lips shriveled and white; constriction of throat; quick, irregular pulse; cold extremities; suppressed urine; syncope; convulsions and death. If the patient recovers, death may occur in a few weeks on account of irritation of the kidneys with resulting uræmia.

TREATMENT: First administer the chemical antidote, which is albumin (the white of one egg for each 4 grains of the poison taken); promote vomiting by the use of copious draughts of albumin water; then administer demulcent drinks, milk or ice water. Too much albumin should not be given as albuminate of mercury is resolvable in an excess of albumin.

Caustic alkalies. (Corrosive.)

SYMPTOMS: See general symptoms of corrosives.

TREATMENT: Same as for hydrochloric and other mineral acids except that to neutralize the alkali a dilute solution of an acid is used. *It must be remembered that dilute hydrocyanic (prussic) acid must not be used.*

Cocaine. (Neurotic.)

SYMPTOMS: Excitement, talkativeness, hallucinations, followed by marked depression; small and rapid pulse; slow respiration; cyanosis, dilated pupils; collapse.

TREATMENT: Wash out the stomach with a solution of potassium permanganate (20 grains to 1 pint of water) or tannic acid or tea. Keep patient in recumbent position; apply external heat; artificial respiration if necessary.

Physiological antagonists are morphine, amyl nitrite, chloral, chloroform, and ether.

Digitalis. (Neurotic.)

SYMPTOMS: Muscular weakness; sneezing; nausea; vomiting; colic and purging; headache; irregular heart action; vertigo, and disordered vision; respiration rapid and feeble; cyanotic skin; coma and convulsions. Death occurs by sudden paralysis of the heart.

TREATMENT: Wash out the stomach with tannic acid solution or tea or potassium permanganate (20 grains to 1 pint of water). Patient to be kept quiet and in a recumbent position. Warmth to extremities.

Physiological antagonists are aconite for the effects of a large dose and opium for the effects of its long continued use. Saponin and senegin are considered to be its most complete physiological antagonists.

Food poisoning.

SYMPTOMS: Those due to the special nature of the poisoning substance are described elsewhere in this and other chapters.

TREATMENT: Must be adapted to the individual conditions found. If early treatment is possible, remove harmful contents from alimentary tract by use of stomach tube or emetics, high colon flushing, and active catharsis if there is no reason to suspect the presence of appendicitis or perforation of the intestine. Saline infusion given hypodermically or intravenously should be used to aid in the elimination of the poisonous or noxious substances from the circulation. (This should be done by medical officers only.)

Heroin. (Neurotic.)

See Morphine.

Hydrochloric acid. (Corrosive.)

SYMPTOMS: Pain throughout digestive tract; vomiting; feeble pulse; cold, clammy skin; collapse; dried crusts of burnt tissue about mouth; yellow stains on clothing but none on the skin.

TREATMENT: Weak solution of alkalies, washing soda, soapsuds, etc., to neutralize the acid; *do not use stomach tube*. Give olive oil, barley water, linseed tea, mucilage of acacia, albumin or milk to protect the membrane and stimulants to combat the resulting depressed condition of vital powers.

Hydrocyanic (prussic) acid. (Neurotic.)

SYMPTOMS: Sudden unconsciousness; slow, labored respirations; slow pulse; staring eyes; purple face; general convulsions, then relaxation and collapse; odor of peach kernels on breath; death may be almost instantaneous.

TREATMENT: Stomach tube if possible. Dilute ammonia; opium, to relieve pain, alternate cold and warm affusions; atropine and heart stimulants; artificial respiration.

Hyoscyamus. (Neurotic.)

Symptoms and treatment same as atropine and belladonna.

Iodine. (Irritant.)

SYMPTOMS: Acrid taste in mouth; pain and sense of great warmth in throat; intense thirst; vomiting and purging (vomited matter contains traces of iodine); vertigo; cyanosis; swollen eyelids; convulsive movements and collapse.

TREATMENT: Free administration of starch in water or any starchy substance; induce vomiting; give demulcent drinks; stimulants, hypodermically; external heat; careful nursing.

Irritant gases.

SYMPTOMS: Irritant gases produce irritation and corrosion of the respiratory tract, causing bronchitis, which may be more or less severe. Irritation of the eyes, mouth, stomach, and kidneys also are produced.

TREATMENT: Remove the patient from the source of the gas; give inhalations of ammonium and begin artificial respiration at once. When free respiration is established, give magnesium oxide or the dilute alkalies.

Lead.

SYMPTOMS: A sense of constriction about the throat; cramps; stiffness of abdominal muscles; blue line around the gums; paralysis of upper limbs; dropped wrist; vomiting of white flaky matter and constipation.

TREATMENT: Free administration of soluble sulphates, followed by milk and raw eggs; give emetics and use stomach tube; opium to allay irritation. (Chronic poisoning is best treated by iodides to saturation of the system, sodium iodide or calcium iodide being the best. (Painters are subject to chronic lead poisoning.)

Morphine. (Neurotic.)

SYMPTOMS: Begin with giddiness, drowsiness, and stupor. Usually there is a period of exhilaration followed by a period of depression; slow, stertorous breathing; cold, clammy skin; livid countenance; slow pulse; muscular relaxation; pupils contracted (pin point); total insensibility to external impressions; deep sleep from which, if the patient be aroused, there will be an irresistible predisposition to go back to sleep. Death occurs by paralysis of the respiratory center,

TREATMENT: First remove the poison from the stomach by the use of the stomach tube or emetics. The stomach wash, if used, should contain 20 grains of potassium permanganate to the pint of water. After the stomach has been washed out with this solution, a little (about 1 fluid ounce) should be left in the stomach. In the absence of potassium permanganate an emetic should be administered hypodermically (emetics by mouth are generally useless), and after evacuation of the stomach the use of tannic acid in some form. Cathartics and diuretics should be administered to prevent absorption. Caffeine or strong coffee is very efficient. Efforts should be made to keep the patient awake, but no violence should be used. Oxygen and artificial respiration, if necessary.

Physiological antagonists are caffeine, cocaine, ammonia, strychnine, amyl nitrite. Atropine ($\frac{1}{80}$ grain) may be used, but only one dose should be given.

Nitric acid. (Corrosive.)

SYMPTOMS: Same as for hydrochloric acid, except that there are likely to be yellow stains about the face and lips.

TREATMENT: See hydrochloric acid.

Nux vomica. (Neurotic.)

See strychnine.

Opium. (Neurotic.)

See morphine.

Oxalic acid. (Corrosive.)

SYMPTOMS: Burning pain in mouth, throat, and stomach; destruction of membrane by contact; intense thirst; difficulty in speaking and swallowing; tetanic convulsions; coma and collapse; clothing stains dark brown to red; tissues are stained white or brown.

TREATMENT: Do not use the stomach tube; give chalk, limewater, or if necessary use plaster off the walls, powdered and mixed with water. Follow with mucilaginous drinks and oils. *Do not use alkalis of sodium or potassium to neutralize this acid.*

Phenol (carbolic acid). (Corrosive.)

SYMPTOMS: White burns about mouth, lips, tongue, and throat. Burning pain in the mouth, throat, and stomach; patient becomes comatose rapidly; stertorous breathing; contracted pupils; subnormal temperature; collapse.

TREATMENT: Neutralize the acid by the administration of magnesium sulphate or sodium sulphate (any soluble sulphate) first. Then administer emetics and follow with stimulants, such as ether, atropine, or coffee; give demulcent drinks; apply hot-water bags and warm blankets. *Do not give alcohol, oils, or glycerin*, as they will cause the absorption of the drug. Alcohol may be used for the local burns.

Strychnine. (Neurotic.)

SYMPTOMS: A sense of suffocation and inability to breathe; shuddering and jerking of the muscles; sense of stiffness about the neck; twitching and jerking of lower limbs and quivering of entire body; convulsions—the body becoming rigid and curved forward, backward, or to one side; the features assume a peculiar grin called the "*risus sardonicus*"; rapid pulse; tetanus. Patient remains conscious until the end and is fully aware of what is going on about him.

TREATMENT: Emetics administered until free vomiting is induced. Potassium permanganate (20 grains to the pint of water) as a chemical antagonist; if this is not at hand, use tannin in any form. Chloroform inhalations to relieve

pain and quiet spasms. Chloral hydrate and potassium bromide in large doses are useful. Patient must be kept in a recumbent position during treatment and must be kept in a dark room remote from all noises.

Sulphuric acid. (Corrosive.)

SYMPTOMS: Same as hydrochloric acid, except that tissues about mouth and face are burned very dark brown or black.

TREATMENT: See hydrochloric acid.

Trinitrotoluene (T. N. T.) poisoning.

Because of the extensive use of this substance on board ships and in naval magazines ashore, poisoning caused by it is not uncommon.

SYMPTOMS: The skin of the hands, arms, and exposed parts become seriously irritated and inflamed. When the fumes are inhaled the respiratory tract is irritated and there is a destruction of the blood corpuscles, with a loss of hæmoglobin resulting in anemia. The patient complains of headache, nausea, vomiting, vertigo, and general muscular weakness. Bile pigments are present in the urine and the skin and hair frequently turn yellow. Chronic poisoning results in a temporary enlargement of the liver, with subsequent atrophy, and in degeneration of the kidneys. Prophylactic measures consist of applying a solution of shellac, castor oil, and alcohol to the exposed parts of the skin, or, better, cover the arms with stockings and the hands with gloves impregnated with this solution. The entire face should be covered with a special mask, containing glass or other transparent noninflammable material, so that there may be no interference with vision.

TREATMENT: The poison may be removed from the skin with a solution of sodium hyposulphite. Remove the patient from the vicinity of the substance, provide absolute rest, fresh air, and simple diet. Large amounts of water with large doses of sodium citrate and sodium bicarbonate should be given. Restrict the meat intake, give small doses of iron daily, and regulate the bowels.

Gasoline and benzin poisoning.

Gasoline poisoning frequently results from exposure to the fumes in motor launches and in places which are confined and shut off from free access to the outside air. Men attempting to siphon gasoline from a container by means of a hose frequently swallow an amount which is harmful.

SYMPTOMS: From the fumes; at first, giddiness, a feeling of contraction of the head with severe headache, later, partial or complete insensibility, facial cyanosis or flushing, and a tendency to mania during the return to consciousness.

TREATMENT: Remove the patient to the open air, remove all gasoline-soaked clothing, apply external heat if necessary. Administer stimulants (by enema if necessary) and treat symptomatically. (See below under treatment for carbon monoxide poisoning.)

Symptoms from the ingestion of gasoline resemble those caused by acute alcoholism, the patient is very apt to develop mania and later become unconscious. This condition should be treated by emptying the stomach by means of a stomach tube, followed by washing the stomach with very dilute potassium permanganate solution, then with warm water. It is advisable to administer two ounces of a solution of magnesium sulphate before withdrawing the stomach tube. Treat symptomatically by applying external heat, stimulants when indicated, etc.

NOTE.—Carbon monoxide is contained in the fumes of gasoline and benzin, and when inhaled results in the formation of carbon monoxide hæmoglobin. The treatment indicated is: (1) Remove the patient from atmosphere containing monoxide; (2) administer oxygen as quickly as possible and in as pure a form as is obtainable, preferably from a cylinder of oxygen through an inhaler mask; (3) if breathing is feeble, start artificial respiration at once by prone-posture method; (4) keep the patient flat, quiet, and warm; (5) afterwards give plenty of rest.

The following table gives the most prominent symptoms of poisoning by some of the more common poisons:

Symptoms.	Lead us to suspect poisoning by—
Poison suddenly fatal.....	Hydrocyanic acid; potassium cyanide; phenol; oxalic acid; poisonous gases.
Collapse, with cold clammy skin and rapid pulse.	Corrosive acids or alkalis; arsenic; antimony.
Convulsions.....	Strychnine.
Coma.....	Alcohol; opium (preparations); chloral hydrate; carbon monoxide or dioxide.
Active delirium.....	Alcohol; atropine; belladonna; hyoseyamus; cannabis indica; camphor.
Mental hebetude.....	Opiates (chronic); cocaine (chronic).
Double vision.....	Belladonna; gelsemium.
Blindness.....	Methyl (wood) alcohol.
Ringings in the ears.....	Quinine; salicylic acid, chenopodium.
Salivation (ptyalism).....	Mercurials; aconite; pilocarpine.
Pupils—	
Dilated.....	} Atropine; homatropine; gelsemium; hyoscyamus.
Contracted.....	
Skin—	
Moist.....	Opiates; aconite; pilocarpine; salicylic acid and salicylates.
Hot and dry.....	Atropine; cocaine; scopolamine.
Cyanotic.....	Carbon dioxide; coal-tar products.
Dark but not cyanotic.....	Mercury; lead; arsenic.
Yellow.....	Phosphorus; potassium chlorate or nitrate.
Eruptions.....	Bromides or iodides internally; croton oil, poison oak or ivy externally.
Numbness and tingling.....	Aconite; beginning lead palsy.
Discoloration of tongue and membranes of mouth and throat—	
White.....	Corrosive acids; alkalis; phenol; bichloride of mercury.
Yellow.....	Nitric acid (changing to brown).
Brown.....	Iodine; bromine; potassium permanganate.
Greenish blue.....	Copper salts; Paris green.
Vomiting and purging.....	Arsenic; antimony; mercuric salts; ptomaines.
Vomiting without purging.....	Apomorphine; aconite.
Obstinate constipation.....	Lead; opiates.
Pulse:	
Slow.....	Opiates; digitalis (at first); physostigmine.
Rapid.....	Atropine; hyoseyamus; cocaine.
Great muscular weakness.....	Aconite; digitalis; physostigmine; salicylic acid; carbon dioxide.
Muscular tremors.....	Lead; mercury; alcohol.
Urine:	
Yellow.....	Santonin; picric acid.
Red.....	Sulphonal; trional.
Dark, smoky, or greenish.....	Phenol; tar; creosote.
Scanty or suppressed.....	Oxalic acid; atropine; potassium chlorate or nitrate.
Strongly acid.....	Mineral acids; oxalic acid.
With odor.....	Turpentine; copaiba; cubeb.

THE MANAGEMENT OF A POISON CASE, THE NATURE OF THE POISON BEING UNKNOWN.²

In a case of poisoning when the nature of the poison is known the antidote and general treatment to be followed is often indicated with precision. However, cases frequently are met with when it is almost impossible to obtain much or any information relative to the nature or type of poison taken. Any delay in treatment may result in serious consequences. Therefore every hospital

² Prepared by Chief Pharmacist C. Schaffer, United States Navy.

corpsman should possess some practical knowledge of how to manage a poisoning case when the nature of the poison is unknown.

For the purpose of general treatment in unknown poisons, the case may be considered as one of two kinds; it may be either a case where the local effects of the poison have injured the mucous lining of the mouth, œsophagus, and stomach to an extent contraindicating the use of instruments or emetics for evacuating the stomach; or, it may be a case where the poison has had but little or no local effect on the mucous lining of the alimentary tract, and therefore one in which it would be safe to use a stomach tube or an emetic.

Poisons coming under the classification of "Corrosives" generally produce conditions such as mentioned in the first instance. They have a more or less injurious and even destructive effect on the lining of the mouth and stomach, and naturally in such cases the introduction of any sort of instrument, even a soft rubber stomach tube, may result in a perforation in the weakened wall; in such conditions, even rupture of the stomach may be caused by emesis. Poisons classified under "Irritants" and "Neurotics" have generally no special local or injurious action on the mucous membrane of the mouth and stomach, and therefore in such cases the stomach may be evacuated and washed by the aid of a stomach tube, or in the absence of a stomach tube the use of emetics could be resorted to without fear of injury.

Even when the exact nature of the poison is unknown, one seldom finds it difficult to determine whether the offensive material belongs under the classification of "Corrosives" or not; a corrosive leaves unmistakable signs about the lips and mouth. When the local condition points to a corrosive poison, the evidence usually indicates also whether it is of the acid or alkali type. In the case of an acid, the general treatment is the same as that outlined above under "Hydrochloric acid," while the general treatment for almost any strong alkali is outlined above under "Caustic alkali." In neither case is the stomach tube or emetics employed.

In cases where there are no signs of injury to the lining of the mouth, the probabilities are that the poison is one of the so-called "Irritants" or "Neurotics"; that is, the poison may be a salt of one of the poisonous metals, as arsenic, mercury, copper, tin, zinc, silver; or it may be one of the alkaloidal drugs of opium, belladonna, nux vomica, or perhaps one of the many alkaloids, among the more common of which may be mentioned morphine, codeine, cocaine, heroin, atropine, and strychnine, although in an unknown case it would hardly be strychnine, for the symptoms in a case of strychnine poisoning are very characteristic. The patient may be suffering from poisoning by one of the drugs known as glucosides, of which the active principles of digitalis are examples; or, the case may be one of poisoning by grain alcohol, wood alcohol, chloral, a cyanide, phosphorus, iodine (leaves stains on lips), or phenol (the undiluted form has corrosive action).

Almost the entire range of possibilities for poisons coming under either the classification of "Irritants" or "Neurotics," may be treated with a general antidote having properties of precipitating them, or of physically or chemically combining with those poisons in a manner to reduce their toxicity and, in some instances, to convert them into altogether harmless compounds. The following is considered an excellent general antidote: Take one tablespoonful of magnesium oxide, 1 tablespoonful of tannin (tannic acid), 3 tablespoonfuls of powdered charcoal, and a small amount of water and mix together into a paste, thin the paste by further addition of water, about half filling an ordinary glass tumbler. This general antidote is administered in doses of from 1 to 2 ounces each. Wash the stomach with lukewarm water or saline solution be-

tween doses of the antidote, which should be repeated at intervals of 10 minutes so long as may appear necessary. Occasionally, after washing out the stomach and between doses of antidote, give the patient a thin paste of starch, the white of two eggs or other albuminous substance.

Always use the stomach tube when possible under the circumstances; the stomach tube facilitates the administration of antidotes as well as the washing out of the stomach at short and frequent intervals, and permits the handling of the case in a positive manner, in so far as it places under control the administration of emergency treatment. When the stomach tube is not used, the patient is required to assist and work on himself; he must swallow large volumes of antidotal mixtures, saline solution, warm water, and besides he must take emetics to promote vomiting. All such efforts on the part of the patient have a tendency to weaken him and thereby lower his general resistance. However, when for any reason the stomach tube is not employed, antidotes must be taken by mouth and removed by emesis, which may in some cases be brought on by the tickling of the fauces but more often requires the use of emetics, the following being a very effective one and very easily prepared: About 2 teaspoonfuls of mustard in glass of warm water. Soapy water is an excellent emetic, made by dissolving castile soap in water, this also has antidotal action on a number of metallic salts, principally mercuric chloride. Two teaspoonfuls of table salt dissolved in a glass full of warm water is sometimes used as an emetic with good effect.

After removing the residual poison from the stomach by the use of the stomach tube or emetics, magnesium sulphate should be given in small doses until a total of about $1\frac{1}{2}$ ounces have been taken. No oils should be given unless it is certain that the patient is not suffering from an oil-soluble poison such as phosphorus or phenol.

The above outline relative to the management of poison cases when the nature of the poison is not known covers only those steps that have to do with the removal of unabsorbed portions of poison, the residual poison, from the stomach, but the hospital corpsman should not lose sight of the fact that the treatment also calls for the application of proper measures to counteract that portion of the poison that may have been absorbed and carried in the system of circulation. No definite outline of treatment can be laid down for combating the possibilities which may arise from absorbed poisons; this part of the treatment is based entirely on the symptoms the case presents. Efforts to hasten the elimination of absorbed poison would include the giving of large quantities of water, the use of hot packs to stimulate skin action, probably the use of enemas if deemed advisable under the circumstances.

The hospital corpsman should endeavor to alleviate symptoms and distress of the patient by such means as come within his knowledge and experience in the general care of the sick, using hot water bags, ice bags, etc., as indicated. Physiological antagonists should not be administered in the absence of definite information as to the nature of the poison ingested. Medication should be limited to drugs whose physiological action is clearly understood by the hospital corpsman.

REFERENCES.

- Medical Jurisprudence and Toxicology.—Glaister.
Preventive Medicine Section of Naval Medical Bulletins.
Legal Medicine and Toxicology.—Peterson, Haines, and Webster.

CHAPTER X.

BACTERIOLOGY, BLOOD WORK, AND IMMUNITY.¹

This section on bacteriology and hæmatology is not intended to serve as a working manual for laboratory use, but rather to outline the principles involved, the general methods, and something of the application of the more common procedures. Details of technique that are absolutely essential for the proper performance of any test are available in the manuals of laboratory work that are supplied to the medical department of all ships and stations.

The microscope.—The most important single piece of apparatus in a laboratory is the microscope, and it must be used and cared for accordingly. It is used to magnify and so make visible to the eye very small bodies, such as bacteria, the eggs of intestinal parasites, and the material found in urine sediments. A simple microscope is nothing more than a single magnifying lens. A compound microscope, which is the type used in medical laboratories, consists of a number of such lenses arranged in line so as to give a very great magnification, even up to 1,000 times the actual size. Complete and detailed descriptions of microscopes are to be found in all books on laboratory work. The working parts of the instrument are illustrated in figure 179.

Before attempting to use a microscope for the first time one should read over a description of its parts and their functions so that it will be possible to adjust the light and the lenses properly. There are a few important things to keep in mind regarding its use, and they are: Never leave the microscope exposed to direct sunlight, excessive heat, or splashing water; never use ether, alcohol, or xylol to clean it, as they all destroy the finish; never pick it up by any of the movable parts; never leave immersion oil on the lens or objective, as it is called, but wipe it off immediately after use with a fine, soft cloth or with special lens paper; when not in use see that it is well covered to protect it from dust.

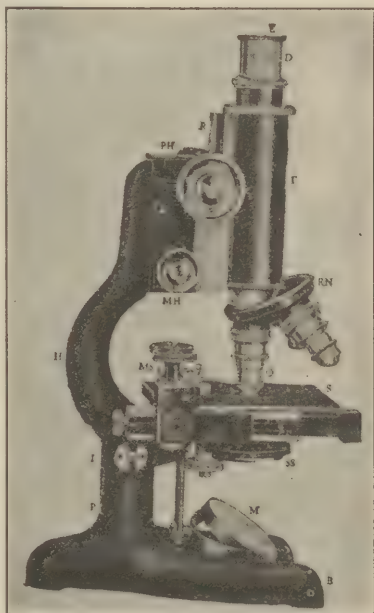


FIG. 179.—Parts of microscope: E, Eyepiece; D, drawtube; R, rack; PH, pinton head; T, body tube; MH, micrometer head; RN, revolving nose piece; O, objectives; MS, mechanical stage; S, stage; H, handle; SS, sub-stage; I, inclination joint; P, pillar; M, mirror; B, base. (Stitt.)

¹ Prepared by Lieut. J. H. Chambers, Medical Corps, United States Navy.

Micrometry is the measurement of microscopic bodies. The unit is called the *micron* and is one one-thousandth part of a millimeter, or $1/25,000$ of an inch. A glass disk, with a scale etched on it, is inserted in the eyepiece of the microscope and there it is at the level at which the image of the object on the stage is brought to a focus. The lines of the scale seem to cut the object and the number of divisions of the scale covered by the object are noted. The scale must be standardized for each objective of each microscope it is used with. Since the value in microns of one division is thus known and, knowing how many divisions are covered by the object, its size is determined by multiplying these values.

Culture media are the materials used for the growth of bacteria in the laboratory. Simple media are so made that they simulate to greater or lesser degree

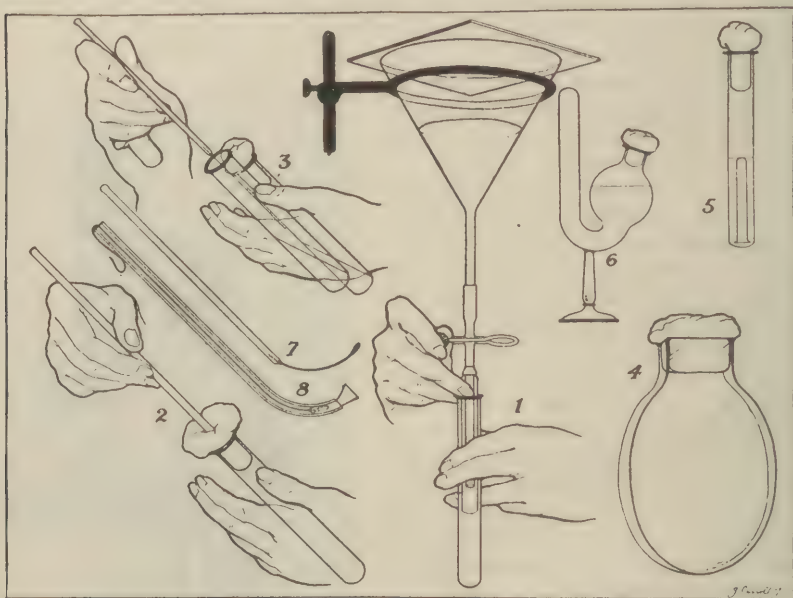


FIG. 180.—1, Filling tubes; 2, plugging tubes; 3, inoculating tubes; 4, culture flask plate; 5, Durham fermentation tube; 6, Smith fermentation tube; 7, pharyngeal loop for meningococcus pharynx cultures; 8, West tube for same. (Stitt.)

the conditions present in the human body, where the bacteria have been growing. The basis of most media is bouillon or broth which is a solution of meat juice, salt, and peptone in water and having a definite degree of acidity. The acidity may be determined by titration, as described in the section on chemistry. The more modern and satisfactory method is to determine the hydrogen ion concentration or its *pu* value. The usual *pu* value is about 7.5, approximating that of blood. A few bacteria require media of other values for their cultivation. Simple nutrient broth may be modified by the addition of agar, making it solid, and known as nutrient agar. To the latter blood may be added, producing blood agar. In the same way other body fluids, such as hydrocele fluid, may be added, making the enriched media required by some of the more delicate organisms. Other substances are used as media, such as milk, broth with sugars added, coagulated blood serum (Löfflers, particularly useful for *B. diphtheria*), and many others used for

special purposes. Milk is used to determine whether the organism produces acid by fermenting the lactose of the milk (shown by a change in the litmus indicator) and whether it produces enzymes that will coagulate the milk. Sugar broth is used in fermentation tubes (Fig. 180) and always contains an indicator such as litmus. If an organism produces acid, the indicator changes color. If it produces gas as well, some of the gas is collected in the closed branch of the tube. The various activities of organisms on culture media, such as the appearance of the colony, production of acid and gas in one sugar and not in another, have been classified and serve to identify the specific organism. Media, after preparation, is put up in tubes—fermentation tubes, flat glass dishes with covers known as *Petri dishes*, or in flasks, and is then sterilized.

Sterilization is accomplished by means of heat, either from streaming steam in an Arnold sterilizer or by steam under pressure in an autoclave. Glassware often is sterilized by dry heat. Fractional sterilization is repeated sterilization at 1 to 24 hour intervals and is employed to kill bacteria developing from spores. As the dust of the air is loaded with bacteria, all media must be kept covered or, if in tubes, plugged with cotton from the time first made.

Bacteria are very small single-celled bodies, visible only through a microscope. They are distributed almost universally in soil, air, water, and in the human body. The mouth and throat contain enormous numbers; milk and butter contain millions. The large intestine contains countless numbers, and a large part of the solid matter of the feces is made up of bacteria. It is evident, therefore, that not all of these bacteria produce disease, and some of them are harmless or even distinctly beneficial to the body and are called *nonpathogenic*. Many bacteria are known to produce disease, and these are called *pathogenic*. In order to study bacteria they are grown on culture media, the different organisms separated out and then grown in *pure culture* for identification. As the majority of bacteria of medical interest grow in the human body the media employed for laboratory growth must be kept at body temperature; hence cultures are kept at a constant temperature of 37.5° C. This is known as incubation and usually is continued for 24-hour periods.

Bacteria are classified according to the appearance of colonies, the shape and arrangement of the individual cells, their color when stained by appropriate methods, whether or not they are motile (have the ability to move from place to place in fluid) by their action on milk and sugar bouillon and by their action on experimental animals. The three usual types are the round organisms, or *cocci*, rod shaped, or *bacilli*, and spiral forms, or *spirillae*. All of them are killed by boiling, many of them by lower temperature if prolonged sufficiently. Some grow only in the presence of oxygen and are called *aërobes*, while others require an atmosphere free of oxygen and are called *anaërobes*. They reproduce by *fission* or simple splitting into parts. Some of them produce bodies called spores that are much more resistant to high temperatures, drying, and cold than the bacteria and serve to produce new organisms when material containing them again is placed in surroundings favorable to bacterial growths.

Stains are substances used to color bacteria and tissue cells so that their morphology may be studied microscopically. They are usually solutions of anilin dyes in water or alcohol, but a few are derived from vegetable substances. The more common stains are hæmatoxylin and eosin, used for tissue staining, and methylene blue, carbol fuchsin, gentian violet, and Bismarck brown for bacteria. Each of these is made up for use in definite strength, alone or in combination with another dye. For some purposes several stains

are applied successively, as part of the material will take up and retain one stain while other parts will react with another dye. This is the principle of Gram's method and of acid-fast staining for tubercle bacilli.

Smears are thin spreads of pus, blood, bacteria, or similar material on a glass slide. They may be made from material from the throat, from sputum, from an abscess, or of blood. The first essential for a proper bacteriological examination is a good smear, and the chief difficulty is to get it thin enough. If a culture is to be examined, place a loopful and not a drop of distilled water on a perfectly clean glass slide and with a sterile platinum wire rub up some of the bacteria in the water, spreading it over as large an area as

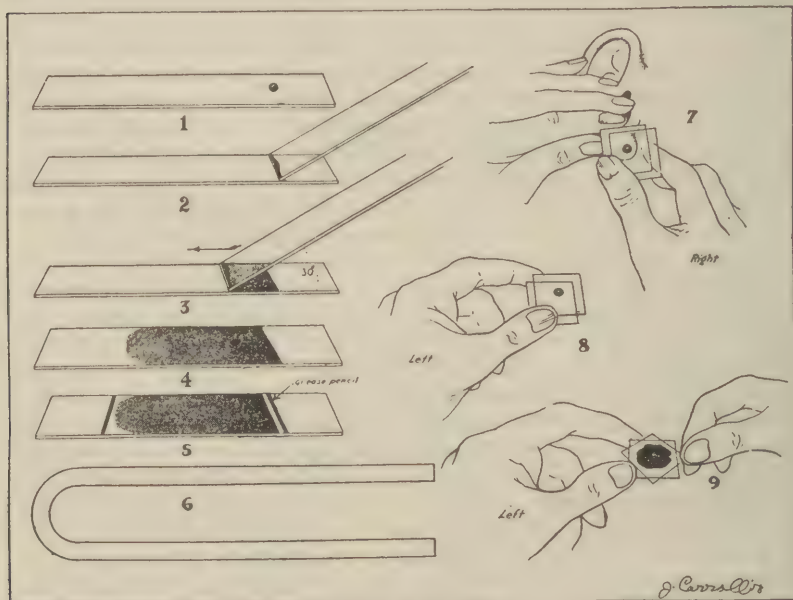


FIG. 181.—1, 2, 3, 4, Making blood smears on slide; 5, smear ready for staining—grease marks prevent Wright stain from running over slide; 6, U-shaped glass tubing to hold slide in staining; 7, right hand holding two cover glasses—one cover glass is being touched to drop of blood from ear; 8, cover glasses transferred to left hand in preparing to place one cover glass on another and spread film; 9, separating cover glasses by sliding one from the other. (Stitt.)

possible. If the bacteria are in fluid media, the water is not needed. For examination of pus use a cotton swab or a loop and spread out just enough of the material to make a visible film on the slide. Smears of sputum should be made from fresh material—that is, material recently coughed up from the lungs—and as free of mouth secretions or saliva as possible and collected in a clean container. For the smear select a thick lump of mucus and avoid the frothy, watery saliva. Smears are allowed to dry in the air and then are fixed to the slide by passing through a flame two or three times. Blood smears should not be fixed by such heating. The smear then is ready for staining with whatever dye is indicated, Gram's method, employing anilin gentian violet, Gram's iodine solution, alcohol, water, and Bismarck brown, being the best routine process.

A complete *blood count* includes the determination of the number of red and white cells in 1 cubic millimeter of blood, the percentage of hæmaglobin, and a differential count which determines the percentage of each type of white cell present. Cells are so numerous in the blood that it must be diluted to separate them and permit the counting of individual cells. The dilution is accomplished in special pipettes, first taking up blood and then the proper diluting fluid. The pipettes are so graduated that known dilutions may be made. One part of blood to 200 parts of fluid, or a dilution of 1:200 for the red pipette and 1:20 for the white. The pipettes must be clean and dry before use, and this is accomplished by washing out with water, sucking alcohol through to wash out the water, then ether to take out alcohol, and then air to evaporate the ether. The bulb of the pipette or mixing chamber contains a glass bead to aid in thoroughly mixing the diluted blood; and if cleaned properly, the bead will not stick to the sides of the bulb. After taking up blood and diluting fluid, the pipette must be shaken vigorously for about a minute to thoroughly mix the blood and fluid. A drop of the mixture is obtained by discarding the clear fluid from the stem of the pipette and is placed on the ruled surface of a *hamacytometer* or counting chamber. The latter must be scrupulously clean. It should be washed in cool water and dried with a soft cloth. Never wash with hot water, acid, alcohol, ether, or xylol, as these tend to dissolve the cement holding the parts together.

When the proper-sized drop is applied and covered with a thick cover glass provided with the apparatus, there is formed a layer of fluid exactly 0.1 mm. in depth and containing an even distribution of red or white cells, as the case may be. The fluid rests on a surface that is ruled into squares 1 millimeter on a side, and further subdivided into smaller squares. The counting chamber is allowed to stand a few minutes to permit the cells to settle, and then is examined under the microscope. The number of cells in one or more squares is counted, and as the size of each square is known and the depth of fluid the number of cells in 1 cubic millimeter can be determined according to the following formula: The number of cells counted times dilution times area of each square times 10 or the factor required to give a depth of 1 millimeter, all to be divided by the number of squares counted.

For a red-cell count this is expressed:

$$\frac{\text{No. of R. B. C.} \times 200 \times 400 \times 10}{80} = \text{No. of R. B. C. per cu. mm. of blood.}$$

For a white-cell count it becomes:

$$\frac{\text{No. of W. B. C.} \times 20 \times 1 \times 10}{1} = \text{No. of W. B. C. per cu. mm. of blood.}$$

A *differential count* is made on a stained smear of undiluted blood. Smears are made on slides or cover slips that are clean and free of all grease. Smears on slides are made by drawing out a drop of blood on one slide by means of the end of another slide. With cover slips, a drop of blood is taken up on the center of one and a second dropped on it. The blood spreads out rapidly in a thin film and then the slips are separated by a sliding motion. Both methods are illustrated in figure 181.

The smears are dried in the air and then stained with one of the blood stains. The majority of the latter are modifications of the Romanowsky method and are solutions of dyes in methyl alcohol. With alcoholic stains no fixation is required before the stain is applied, the alcohol fixing the cells. Water is

added to the stain on the smear and allowed to react, washed off with water, and allowed to dry. Never blot blood films. If other types of stain are used, the films must be fixed before applying the stain. Examination is made with the oil immersion objective of the microscope and a count of 100 cells made. The number of each type of white cell then gives the percentage of each.

In disease there is usually an alteration of the percentage of the various types, and in certain diseases abnormal or pathologic cells appear. Among the latter are the myeloblasts and myelocytes of myelogenous leukemia and the lymphoblasts of lymphatic leukemia. The stained smear also is used to demonstrate the presence of malarial parasites, the staining qualities of the red cells, and their shape, size, and whether or not any of them show nuclei.

Hæmaglobin is the coloring matter of the red cells and is estimated by comparing the color of a drop of whole blood or of chemically treated blood with appropriate color scales and reporting as per cent of normal.

Blood cultures are made to determine whether bacteria are present in the blood stream, thus serving as an index of the nature of the disease in some cases. Ordinarily about 10 to 20 c. c. of blood is required. It is taken from a vein by means of a needle and syringe or a needle connected by sterile tubing with a flask, observing strict asepsis throughout. The skin over the vein must be prepared according to any standard surgical technique and protected from contamination prior to the taking of the blood. The blood is received in sterile containers and transferred to appropriate media. Usually it is added to bouillon and in varying proportions to melted agar that has been cooled below 45° C. and then is poured into Petri dishes and incubated.

Blood for the Wassermann reaction, Noguchi reaction, or for chemical examination is taken in the same manner, preparing the patient's arm, constricting above with a tourniquet, and puncturing a vein with a needle. Here, since absolute asepsis of the blood is not required, the blood may be permitted to run from the end of the needle into a tube, but it is better to collect it in a closed system of apparatus.

Dark-field examinations usually are made on serum from sores on the genitalia to detect the *Treponema pallidum*, the organism causing syphilis. For this purpose a special substage condenser is put into the place of the ordinary Abbe condenser of the microscope. It is so constructed that light rays are prevented from passing directly from the mirror to the objective by a light-proof black surface. Light is reflected by means of mirrors around the sides of this dark field and so illuminates the organisms or cells that may be present in the fluid on the slide. Ordinary daylight is not sufficient, and special lamps ordinarily are required.

To make the preparation, the suspected sore is cleaned of all accumulated secretions with sterile gauze and salt solution. Then it is rubbed sufficiently to promote a flow of serum but not to draw blood. A drop of this material is placed on a slide and immediately covered by a cover glass and examined while still moist. The *Treponema pallidum* is examined in a dark-field preparation because it does not take the ordinary dyes, and when stained by one of the more complicated methods loses many of its characteristics. Other organisms may be seen in the dark-field preparation, but as they are stained easily, this method is not employed. There are a number of spiral-shaped organisms that occur in ulcerative lesions, so great care must be exercised in making a positive report of *Treponema pallidum*.

Immunity is the term applied to that power which prevents the gaining of a foothold by disease organisms in the animal body, or which neutralizes their harmful products or destroys the parasites. Its effectiveness depends upon

two main factors—the power of resistance of the human body and the aggressiveness or virulence of the invading organism. Immunity may be *inherent* or *acquired*. *Inherent immunity* is present from birth and is represented best by the immunity of certain animals to specific infections. It is of theoretical interest but of little practical value in diseases of human beings. *Acquired immunity* is that which results from an attack of a disease, called naturally acquired immunity; or from inoculation of the individual with killed specific organisms or their products and known as artificially acquired immunity. Not all diseases confer immunity by their attack, nor is it possible to produce artificial immunity to all diseases.

Artificially acquired immunity may be *active* or *passive*. When the body is infected by disease, or when the causative organisms of a disease are injected into the body, substances are produced that combat that disease, leading to cure and in some cases to the production of prolonged immunity to that disease. These agents that combat the disease are known as antibodies, and if antibodies against a specific disease are produced in the body the immunity is known as *active immunity*. If the antibodies are produced in one animal and the serum of that animal then injected into another, they produce an immunity; but since the cells of the second individual played no part in the formation of the antibodies, the immunity is called *passive*.

Antibodies are of many types, and the following may be demonstrated in the blood serum: *Agglutinins*, *precipitins*, *opsonins*, and *bacteriolysins* or *cytolysins*. Certain bacteria produce soluble poisons known as *toxins*, which are neutralized by *antitoxins* formed by the body to produce cure of the disease. Toxins and antitoxins have their most familiar application in diphtheria. The danger of diphtheria usually is due to the toxin produced by the bacteria and absorbed by the body. Toxins may be produced in laboratory cultures and antitoxins in animal bodies, and the two standardized against each other and so measured in terms of units. The unit of toxin is that amount that will kill a 250-gram guinea pig in just four days and is called the *Minimum Lethal Dose* or *M. L. D.* The unit of antitoxin for human use is 100 times the amount required to neutralize one *M. L. D.* Many thousand units of antitoxin may be required for the treatment of an attack.

Some individuals have an immunity to diphtheria because of the presence in their body of the specific immune bodies, or diphtheria antitoxin. The *Schick test* is a means of determining whether or not an individual is immune to diphtheria. The dose for this test is $\frac{1}{50}$ of one *M. L. D.*, which is a very small amount of toxin. It is so prepared that the proper amount of toxin is contained in 0.2 c. c. of solution, and this amount is injected by means of a very fine needle into the skin and not beneath it. If this intracutaneous injection is made properly, there will be a small weal formed by the fluid at the site of injection. The toxin may be destroyed by heating to 60° C., but this, of course, does not destroy the protein material in the solution. Certain individuals are sensitive to injected protein even when no toxin is present and may give a reaction due to the protein alone. For this reason it is necessary to give a control injection of heated toxin, usually on the opposite arm.

If immunity exists, the antitoxin of the body immediately will neutralize the toxin and there will be no reaction. If there is no immunity, the toxin will act as an irritant and will cause redness and slight swelling at the site of injection. If a reaction appears, it may be due to the protein and not the toxin, but in this case there will be a similar reaction at the site of the control injection. If there is a reaction to the toxin and to the protein, the true

reaction to the toxin will reach its maximum intensity by the fourth day and will subside slowly, leaving a small brownish, scaling area, thus distinguishing it from the pseudo-reaction due to the protein. A positive reaction therefore indicates that the individual is not immune. If no reaction appears, there is sufficient antitoxin present to render him immune.

The immunity given by the injection of diphtheria antitoxin is passive and of brief duration, lasting only two or three weeks. More recently mixtures of toxin and antitoxin have been injected, and as this causes the production of specific antibodies the immunity is more lasting. It is highly efficient in the prevention of diphtheria in children.

In the treatment of disease blood serum from an animal that has been immunized against that specific disease often is injected as a curative measure. This is known as *Serum Therapy*. Specific immune serum is used extensively in the treatment of diphtheria and of meningitis when the latter is due to the *meningococcus*. It has been employed in the treatment or prevention of many other diseases such as pneumonia, dysentery, cholera, and tetanus, but not with the same remarkably good results. Specific serum may be given as a protective or prophylactic measure, and in this connection, tetanus antitoxic serum has been of the greatest importance and value.

Immune serum is made by giving repeated injections of the specific causative bacteria or their soluble toxins into animals, horses commonly being employed. The animal becomes immune, and its serum contains specific antibodies, which are collected by bleeding the animal and separating off the serum. This serum when injected into man or another animal will afford protection against that disease, but no other. The injection may be subcutaneous, intramuscular, intravenous, intraspinal, subdural, or into the sheath of a nerve, depending upon the type of infection or the indications for the individual patient. Considerable skill in technique, and knowledge of the nature and function of a serum is required for its proper administration.

The use of serum, either normal horse serum or of specific immune horse serum, often is followed by annoying symptoms and occasionally by severe or even fatal reactions. There are two distinct types of reaction or serum sickness; one a comparatively mild form and the other very severe and usually spoken of as *anaphylactic shock*. Serum sickness is due to the serum itself and not its contained antibodies, and may appear within a day or two of the injection but more often about a week later. The patient usually complains of headache, fever, joint and muscle pains, cedema, and particularly of a rash or of itching weals. Most of these mild attacks of serum sickness clear up readily with rest, mild skin lotions, and catharsis. Adrenalin very often will relieve the urticaria.

Severe reactions occurring immediately after the injection, or anaphylactic reactions represent the very severe form of serum disease. *Anaphylaxis* means the opposite of immunity, or, the patient instead of having any protection against the serum, is more susceptible than normal to that serum, or is *hypersensitive*. One injection of a serum such as diphtheria antitoxin may "sensitize" him so that another injection a few weeks later may produce a very severe reaction. Individuals suffering from asthma, particularly when their asthmatic attacks are provoked by contact with horses, are usually hypersensitive, and will give severe reactions when serum is injected. Before administration of serum it is necessary to inquire of the patient whether he has had previous injections or has ever suffered from asthma. The condition known as *status lymphaticus* almost invariably leads to severe or fatal reactions after injection of serum. If there is any suspicion of sensitization, a very

minute dose (1/50 c. c.) of the serum should be injected subcutaneously. A local reaction, usually an urticarial weal appearing within a few minutes at the site of injection, indicates hypersensitiveness. Such an individual usually may be "desensitized" by repeated subcutaneous injections at short intervals of small doses that are gradually increased.

Anaphylactic shock comes on very rapidly and is marked by restlessness, anxiety, dyspnea, and marked prostration. Fortunately the cases in which this goes on to a rapidly fatal ending are very rare, but since they do occur, they must be kept in mind and serums should be injected only under proper supervision.

Other varieties of anaphylaxis or susceptibility are seen in individuals said to have an *idiosyncrasy* for certain foods, drugs, or other material, such as plant pollens or animal dandruff, hair, or feathers. Reactions to these produce varied symptoms, such as asthma, hay fever, urticaria, or even severe prostration.

An *antigen* is any substance that promotes the formation of antibodies and may be bacterial or cellular in nature.

Agglutinins are those antibodies found in the serum that cause suspensions of bacteria to come together and form clumps. They are employed in the laboratory for two purposes: To identify an organism when the specific agglutinin is known to be present in the serum, or, to identify the agglutinin in the serum when the specific organism is at hand. The first method is the one employed in the Widal reaction for the diagnosis of typhoid fever. In this test the diluted serum of the patient is mixed with a suspension of the specific organism (*B. typhosus*). If the patient has typhoid fever, he will have produced specific antibodies and among them agglutinins. So, if the culture of *B. typhosus* is agglutinated, it means that the patient has typhoid fever, or has been very recently immunized by vaccine against the disease. The second method is used to determine the type of *Pneumococcus* present in cases of pneumonia. The organism is recovered in pure culture from the sputum and then mixed with serum known to contain the specific agglutinins for the different types. The serum with which agglutination occurs shows which type of *Pneumococcus* it is.

Precipitins are those antibodies that have the power of producing a precipitate when the serum containing them is mixed with a clear broth filtrate or a solution of specific organisms.

Opsonins are antibodies that have the power of preparing their specific organisms for phagocytosis or ingestion by the leucocytes.

Bacteriolysins and *cytolysins* have the power of dissolving their specific organisms and cells respectively.

All of these antibodies are specific in that they will react only with the particular antigen that caused their production.

There have been many theories advanced to explain how the antibodies are formed and how they unite with the antigen. The most widely accepted theory is that of Ehrlich. His explanation is that the body cells are damaged by the antigen and in response develop substances that are capable of combining with the antigen to neutralize it. In the production of an active immunity by disease or by inoculation these antibodies, called *receptors*, are produced in great excess over the immediate need for the proper handling of the amount of antigen present and are thrown off into the blood, and as long as they persist the individual is protected against any further damage by that antigen, or he has an immunity against that disease. Receptors are divided into three groups or orders. Those of the first order include the *antitoxins* which unite

directly with the toxin or antigen and neutralize it. In the second order are the *agglutinins* which have the power of clumping their specific bacteria. The receptors of the third order of *amboceptors* are regarded as forming a combining link between the antigen and a substance constantly present in the blood called *complement* or *alexin*. While complement is always present it does not have the power to combine with an antigen unless it is joined to the antigen by a specific amboceptor.

The amboceptor is the antibody used in the Wassermann reaction for the diagnosis of syphilis. In this test an antigen is mixed with complement and the patient's serum. If the patient has syphilis, his serum will contain the specific amboceptor against syphilis and the antigen and complement will be united, producing *fixation of complement*. To determine whether fixation of complement has occurred, red blood cells and an amboceptor specific for such sells is added. In the presence of syphilis the complement will be *fixed* and will be unable to attack the red cells and hence produces no hæmolysis. This is a positive Wassermann reaction. If the patient does not have syphilis, the complement will be free, as there is no specific amboceptor in the serum to unite it to the antigen, and it will be joined to the red cells by the specific hæmolytic amboceptor, producing hæmolysis, or a negative Wassermann reaction. The Wassermann reaction is known as a *complement fixation test*, and by employing the proper antigen such tests may be used in the diagnosis of other diseases, such as tuberculosis and gonorrhœa.

The term vaccination originally was used in connection with cowpox or vaccinia, when employed to produce an immunity to smallpox, but bacterial preparations now are referred to frequently as *vaccines*. *Bacterial vaccines* are suspensions of killed organisms that have been counted. When vaccines are introduced into the body the organisms dissolve and produce substances that stimulate the production of antibodies for that disease. *Autogenous vaccines* are those made from cultures of the organisms obtained from a patient's own disease lesions. *Stock vaccines* are those made from cultures of specific organisms that have been carried in the laboratory. Vaccines are employed as a *prophylactic measure* to prevent disease, or as a *curative measure* in an established infection. The best example of the prophylactic bacterial vaccine is the triple typhoid vaccine, a suspension of killed typhoid, paratyphoid A, and paratyphoid B bacilli, which practically has eliminated these diseases from the military services where it is given routinely. In treatment with vaccines the object is to promote the production of more antibodies and thus bring about recovery, but their use is not always successful.

REFERENCES.

- Practical Bacteriology, Blood Work and Parasitology.—Stitt.
 Bacteriology.—Hiss and Zinsser.
 Diagnostic Methods, Chemical, Bacteriological and Microscopical. (Sixth edition).—Webster.

Animal Parasites of Man.¹

GENERAL CONSIDERATIONS.

While there are many lower forms of animal life that are parasitic for man, only the most common ones will be considered in this chapter. Before discussing the systematic relationships, structure, and life history of these parasites, there are certain terms employed in animal parasitology which it is necessary to understand. Among these are:

¹ Prepared by J. Harper, Lieutenant, Medical Corps, United States Navy.

1. *Hosts*.—The animal in which a parasite undergoes its sexual life is called the definite host, that in which it passes its nonsexual existence the intermediate host. For example: Man is the *intermediate host* of the malarial parasite, the mosquito the *definite host*.

2. *True parasitism*.—By this is understood the condition where the parasite does harm to the host, deriving all the benefit of the association. A good example of this is the hookworm infecting man.

3. *Mutualism*.—In such an association there is mutual benefit to each party of the association. An instance of this would be the oyster crab found inside the oyster shell.

4. *Commensalism*.—Where there is benefit to the parasites but no injury to the host. An example of this would be the *Entamæba coli* in the intestines of man.

5. *Ectoparasites*.—Those living upon the body of the host. Example: Infestation with lice.

6. *Endoparasites*.—Those living within the body of the host. Example: Infection with hookworms.

7. *Male parasites* are designated by the sign of Mars (♂); the *female* by the sign of Venus (♀).

8. The *name* of a parasite consists of its generic and specific names. The first or the generic name always commences with a capital. Example: *Acanthia lectularia*, the name of the bedbug.

CLASSIFICATION.

Practically all animal parasites of man belong to the following zoological phyla, or branches: (1) Protozoa (one-celled animals); (2) platyhelminthes (flat worms); (3) nemathelminthes (round worms); and (4) arthropoda (mites, ticks, and insects).

Protozoa.

These are one-celled animals and are made up of protoplasm, which is divided into cytoplasm and a nucleus. There are four groups or classes of protozoa, (1) rhizopoda, (2) mastigophora, (3) infusoria, and (4) sporozoa. (Fig. 182.)

Rhizopoda.—This class of protozoa moves and secures food by throwing out protoplasmic projections called pseudopodia, or false feet. *Entamæba histolytica*, one of the parasitic intestinal amœba of man, is the important member of this class. It exists in two stages, motile and cysted. Man acts as the definitive host. An intermediate host is not required. It is transmitted by cysts in food or water. Flies may act as carriers. It causes the disease known as amœbic dysentery. Diagnosis is made by finding the motile or encysted amœba in the stools.

Mastigophora.—This class sometimes is called the flagellata and includes those protozoa that move and obtain food by means of whiplike appendages, or flagella. *Trypanosoma gambiense* is an important member of this group. This parasite is fish-shaped, has two nuclei and a long flagellum. It lives in the blood and tissues of man. For its development two hosts are required: A fly (*Glossina palpalis*), the definitive host, and man, the intermediate host. It is transmitted by the fly biting man. It causes the disease known as trypanosomiasis, or sleeping sickness, a disease found chiefly in Africa. Diagnosis is made by finding the trypanosome in the blood or tissues of man.

NOTE: Many zoologists include in this class the Proflagellata (spiral or corkscrew shaped organisms), about which there is considerable controversy as to whether they are animals or plants. Among the important members of this

group are: (1) *Treponema pallidum*, the cause of syphilis. This parasite is transmitted by direct contact, usually venereal. The parasite is found by making a smear or dark-field examination of serum from a chancre; (2) *Leptospira icteroides*, the cause of yellow fever. This parasite requires two hosts for its development, man acting as a definitive host and a mosquito (*Aedes aegypti*) the intermediate host. Twelve days are required for its proper development in the mosquito, therefore a mosquito biting a man suffering from yellow fever can not infect another man for approximately 12 days. The parasites are found by special culturing; and (3) *Borrelia recurrentis*, the organism causing European relapsing fever. Man is the intermediate host, and the body louse (*Pediculus vestimenti*) the definitive host. An African form of this disease is caused by *Borrelia duttoni*, which is transmitted by a tick



FIG. 182.—Parasitic protozoa of man: 1, Adult *Entamoeba histolytica*; 1a, encysted *E. histolytica*; 2, *Plasmodium malariae*, A, B, C, D, various stages; 3, *Trypanosome gambiense*; 4, a, *Treponema pallidum*; b, *Borrelia refringens*; 5, *Balantidium coli*; 6, *Trichomonas intestinalis*; 7, a, adult *Giardia intestinalis*; b, encysted *G. intestinalis*. (Stitt.)

(*Ornithodoros moubata*). Diagnosis is made by finding the parasite in a blood smear.

Infusoria.—This group frequently is called the ciliata on account of the fine, hairlike fringe or cilia that surrounds them. These cilia aid in movement and securing food. *Balantidium coli*, a rather large intestinal protozoan, is the only member of this group of importance to man. It is transmitted similarly to *Entamoeba*, and causes dysentery. Diagnosis is made by finding the parasite in the stool.

Sporozoa.—These protozoa have neither cilia, flagella, nor other organs for movement. They live parasitically in the tissue cells of the host, and reproduce by forming spores. The ones that live in the red blood cells, *Hemosporidia*, are of the most interest medically because they include the parasites that cause malaria. There are three types of malarial parasites of man: (1)

Plasmodium malariae, the cause of quartan malaria; (2) *Plasmodium vivax*, the cause of benign tertian malaria; and (3) *Plasmodium falciparum*, the cause of malignant tertian malaria. These parasites require two hosts for their development, the definitive host, a mosquito (*Anopheles*) and man, the intermediate host. The development in the mosquito requires 10 to 14 days, thus an anopheles mosquito biting a man suffering from malaria can not infect another man until after this time has elapsed. Diagnosis is made by examining a blood smear for the presence of these parasites.

Platyhelminthes.

These parasites are known as the flat worms, and they are divided into two classes: (1) the trematodes or flukes, and (2) the cestodes or tapeworms.

Trematodes or flukes are generally leaflike in shape and vary considerably in size. Characteristic of them is the possession of suckers, by which they hold on to the skin or alimentary tract of their host. They develop from eggs and the larval stage usually is passed in a snail. Some flukes require, in addition to the snail, a second intermediate host, usually a fish. Man the definite host, contracts the parasites by eating insufficiently cooked fish or



FIG. 183.—Important trematodes (flukes) of man. (Stitt.)

by bathing in or drinking infected water. The flukes of importance to man are (Fig. 183): (1) *Fasciolopsis buski*. This parasite lives in the intestines and the diagnosis is made by finding the fluke or its eggs in the stools; (2) *Clonorchis endemica*. An important liver fluke, the eggs of which likewise are found in the stools; (3) *Paragonimus westermani*, the fluke that lives in the lungs. The diagnosis being made by finding the eggs in the fresh sputum; and (4) *Schistosomes*. These are the blood flukes, of which there are three kinds, *Schistosoma haematobium*, *S. japonicum*, and *S. mansoni*. Unlike the other flukes, they are not hermaphroditic, but have separate sex. Diagnosis is made by finding the eggs in the faeces or in the case of *S. haematobium* in both urine and faeces.

Cestodes.

These worms commonly are called tapeworms. They consist of a head and a series of segments. One might consider them a series of flukes united in one long ribbon-like colony. The head, which is a little larger than a pin head, is provided with suckers or hooks, or sometimes both, to enable them to hold on to the intestines. The segments may number several hundred or more. Some tapeworms attain the length of 25 to 30 feet. In treating cases of tapeworm infection, it is important that the head be expelled, otherwise, in

about two months, a full-grown worm again will develop. Among the important tapeworms of man are: (1) *Tenia saginata*. This is the common and widely distributed beef tapeworm. Its head has four large suckers, but no hooklets and often is called the unarmed tapeworm. The segments have a uterus showing 15 to 30 branches. The genital pores are lateral and alternate. Several hundred segments may be present, and the worm varies from 10 to 25 feet in length. Man is the definite host and cattle the intermediate host. Infection is brought about by eating insufficiently cooked beef; (2) *Tenia solium*. This is the so-called pork tapeworm and is not as common as the beef tapeworm. Its head shows, in addition to suckers, a rostellum crowned by hooklets, for this reason often being called the armed tapeworm. The segments have a uterus showing only 5 to 10 branches. Man is the definite host and the hog the intermediate host. Infection is contracted by eating in-

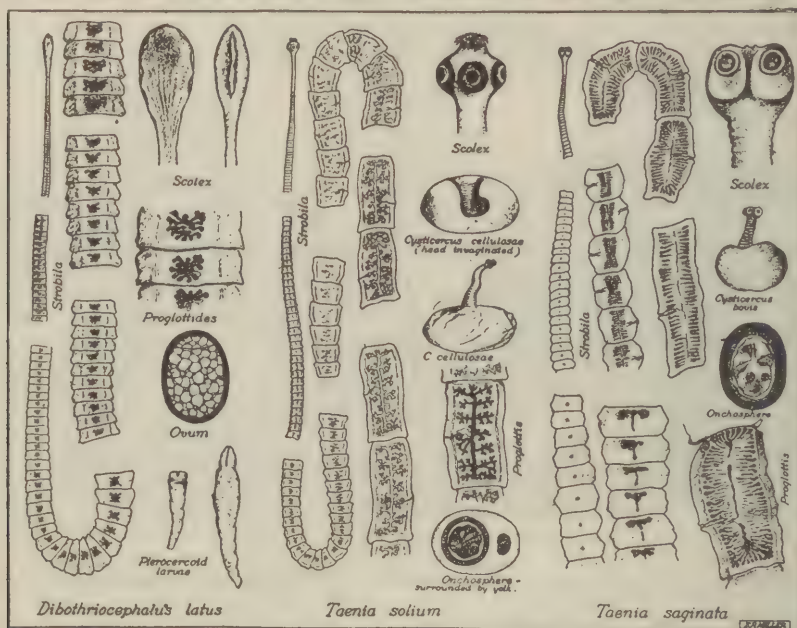


FIG. 184.—Adult and larval stages of cestoda of man. (Stitt.)

sufficiently cooked pork; and (3) *Hymenolepis nana*. This is one of the most common tapeworms and is called the dwarf tapeworm on account of its small size. It reaches only a quarter to a half inch in length. Its head has four segments, and a rostellum, with a single row of hooklets encircling it. There are about 150 to 200 segments. The genital pores are lateral and all on the same side. Man acts as both the definite and intermediate host. As many as a thousand worms may be present at one time. Infection is caused by swallowing the eggs.

The diagnosis of these worms is made by finding their segments or their eggs in the stools. (Fig. 184.)

Nemathelminthes.

These worms are known as roundworms on account of being tubular or filiform in shape. They are not segmented and are covered by a cuticle or skin, which is frequently ringed. An alimentary canal is usually present and

complete. The sexes as a rule are separate. The male usually can be recognized by its smaller size, its curved posterior end, and at times exhibiting an umbrellalike expansion called the copulatory bursa. The most common roundworms are: (1) *Ascaris lumbricoides*, the round or eel worm. This is probably the most common parasite of man, especially children. They average about 6 inches in length and are grayish to reddish in color. An intermediate host is not required. Infection takes place through food or drink or by fingers of children who have been playing where soil pollution exists. The adults live in the intestines; 2. *Hookworms*. (Fig. 185.) These round worms are of con-

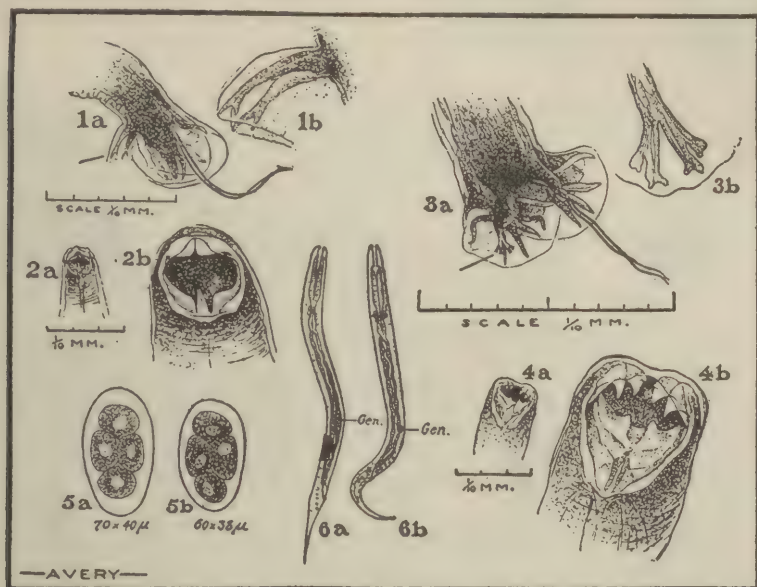


FIG. 185.—1a, Copulatory bursa of *Necator americanus*, showing the deep cleft dividing the branches of the dorsal ray and the bipartite tips of the branches; also showing the fusion of the spicules to terminate in a single barb. Scale 1/10 mm. 1b, Branches of dorsal ray magnified. 2a, The buccal capsule of *N. americanus*. 2b, The same magnified. 3a, Cop. bursa of *Ancylostoma duodenale*, showing shallow clefts between branches of the dorsal ray and the tridigitate terminations. Spicules hair-like. 3b, The dorsal ray magnified. 4a, The buccal capsule of *A. duodenale*, showing the much larger mouth opening and the prominent hooklike ventral teeth. 4b, The same magnified. 5a, Egg of *N. americanus*. 5b, Egg of *A. duodenale*. 6a, Rhabditiform larva of *Strongyloides* as seen in fresh faeces. 6b, Rhabditiform larva of hookworm in faeces 8 to 12 hours after passage of stool. (Stitt.)

siderable importance from a medical standpoint. Human infection comes almost entirely from two types of hookworms, *Ancylostoma duodenale*, the Old World species, and *Necator americanus*, which generally is called the New World species. They average about one-half inch in length. The males are distinguished from the females by their expanded posterior end. The large open mouth of the Old World hookworm has four clasp-like teeth on the ventral side and two noblike teeth on the dorsal aspect. The New World hookworm has a smaller, round mouth, and the ventral teeth are replaced by plates. It also has a prominent dorsal tooth projecting into the mouth cavity. Man acts as the definitive host. An intermediate host is not required. Infection takes place by larva in polluted soil penetrating the skin. From here the larva make their way to the

intestines, where they develop into adults; (3) *Trichuris trichiura*. This usually is called the whipworm on account of the thickened body resembling the handle and the narrow neck the lash. It is one of the most common parasites in both temperate and tropical climates. They average about 2 inches in length. It does not require an intermediate host.

The diagnosis of these three round worms is made by finding the adults or their ova in the stools. (Fig. 186.) (4) *Oxyuris vermicularis*. This parasite commonly is known as the pin or seat worm and is more frequent in children than in adults. The male is about one-sixteenth of an inch and the female about one-half inch in length. The male has an incurved tail with a single spicule, and the female a long tapering tail. The female, loaded with eggs, wanders out of the rectum, and as the result of scratching the

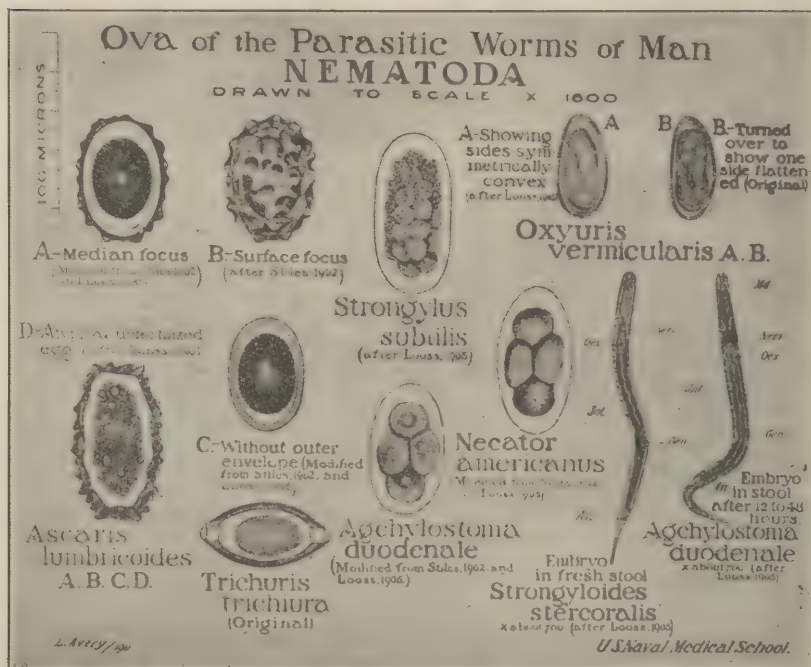


FIG. 186.—Nematode ova. (Stitt.)

fingers become contaminated with the eggs, which may be carried to the mouth and cause a fresh infection. Thus an intermediate host is not required. Diagnosis usually is made by examining the stools for the white, threadlike females which usually are expelled after a purgative; (5) *Trichinella spiralis*. The cause of trichinosis. The adults live in the intestines and are about one-sixteenth of an inch in length. The female does not lay eggs, but gives off larvæ directly. These larvæ wander to the muscles of the body. Man acts as the definitive host and hogs as the intermediate host. Infection is contracted by eating insufficiently cooked pork. Diagnosis is made in the first five days of the disease by finding the adults in the stools, after that time by finding the larvæ in the blood or muscles; (6) *Filaria bancrofti*. This is the most important of filarial worms and causes an infection common in tropical countries. The adult worms live in the lymphatics and are about 2 inches in length. The female normally does not lay eggs, but gives off larvæ, which

enter the blood stream. Characteristic of this parasite is the appearance of the larvæ in the blood stream only when the patient sleeps. Man is the definitive host, and the mosquito, especially the *Culex quinquefasciatus*, the intermediate host. It takes about three weeks for the larvæ to develop properly in the mosquito before they can infect another man. Diagnosis is made by the presence of the larvæ in the blood stream.

Arthropoda.

The other branch of animals with which we are particularly concerned is known as the *arthropoda*, and of these, from a medical standpoint, we are interested in two classes only, the arachnoids and the insects.

Arachnoids.—This class includes the mites and ticks, which differ from the insects in having a head and thorax fused together and possessing four pairs of legs instead of three. A common parasite belonging to this group is the *Sarcoptes scabiei*, the human itch mite. This minute whitish mite causes a skin disease known as scabies. The disease is brought about by the female



FIG. 187.—Ticks: 1, *Ornithodoros moubata*; 2, *Dermacentor andersoni*. (Stitt.)

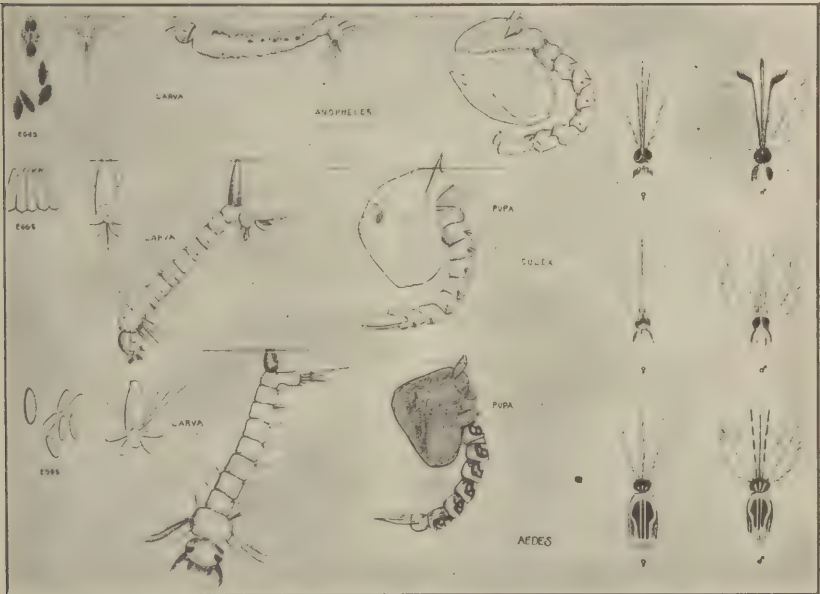


FIG. 188.—Life cycle of the *Anopheles*, *Culex*, and *Aedes* mosquitoes. (Stitt.)

mite burrowing into the skin, where eggs are laid, from which come young mites that are to spread the infection. Diagnosis is made by examining skin scrapings under the microscope for the presence of the mites or their eggs.

The tick family of arachnoids is of great and increasing importance medically. It is of interest that it was with the tick transmission of a disease of cattle in Texas that the zoological principle of transmission of diseases by

means of arthropod hosts was established. Ticks are much larger than mites, readily being seen by the unaided eye. They are wholly parasitic in their habits. Some of them live on their host practically all their lives, dropping to the ground to deposit their eggs. Among the ticks of importance are (Fig. 187): (1) *Ornithodoros moubata*. This tick has a hard, rough skin, and on looking down on its back the head can not be seen. It lives in the huts of

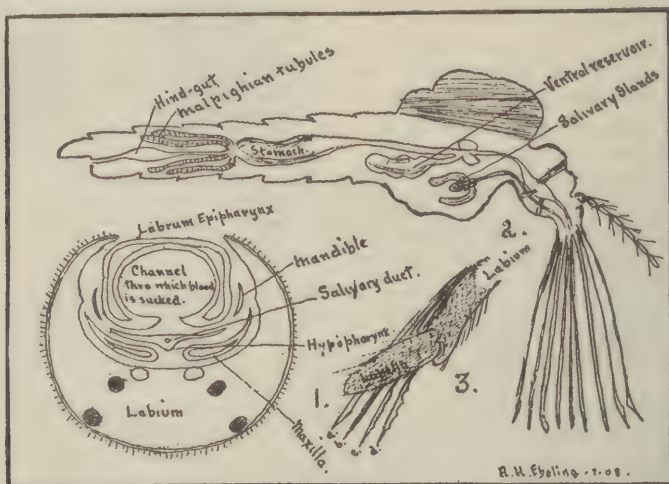


FIG. 189.—Anatomy of mosquito: 1, Cross section of proboscis; 2, anatomy of mosquito, longitudinal section; 3, tip of proboscis: a, labrum epipharynx; b, hypopharynx; c, mandible; d, maxilla. (Stitt.)

the natives of Africa and has habits very similar to the bedbug, feeding at night and hiding during the day. It transmits a protozoan, *Borrelia duttoni*, which causes South African tick fever; (2) *Dermacentor andersoni*. A tick found in the western part of the United States. It can be roughly distinguished from the *O. moubata* on account of its smooth skin and the head parts projecting beyond its body outline. It transmits the spotted fever of the Rocky Mountains.

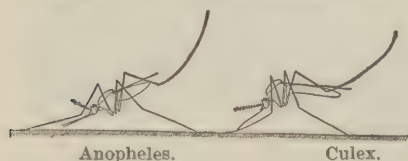


FIG. 190.—Resting positions of *Anopheles* and *Culex* mosquitoes. (Stitt.)

Insecta.—In this class we have the mosquitoes, flies, fleas, lice, and bedbugs. These parasites have three well-marked divisions of body—head, thorax, and abdomen; three pairs of legs and one pair of antennæ.

The *Culicida* or mosquitoes are of the greatest importance medically, not only from their influence upon health in general by reason of interference with sleep and possibly from direct transmission of disease but, more specifically, they are the only means by which it at present appears possible to bring about infection with such diseases as malaria, yellow fever, filariasis, and possibly dengue. In the life history of mosquitoes (Fig. 188) the female lays eggs in water or in places where water is apt to collect, otherwise they will not hatch. In from one to four days a larva or wriggler emerges and comes to the surface to breathe. These larvæ are of two types—the siphonate and the asiphonate.

nate. The siphonate are so called on account of having a breathing tube projecting from the tail end of the abdomen. When seen at rest this tube projects above the surface of the water and the head end of the larva hangs down at an angle. The larva of the mosquito that transmits filaria (*Culex*) has a long, narrow siphon, and the larva of the yellow-fever mosquito (*Aedes*) has a short, barrel-shaped siphon. The asiphonate do not have this tube, but possess breathing slits and at rest float parallel to the surface of the water. This is the larva of the mosquito that transmits malaria (*Anopheles*). This larva has another characteristic feature, namely, fan-shaped hairs on each side of its abdominal segments, called palmate hairs. After about a period of a week the larva enters a non-growing, nonfeeding stage called the pupa, or nymph, from which in about three days the adult mosquito releases itself and flies away.

It is desirable that the anatomical characteristics of mosquitoes be known to those who may have to examine them. (Fig. 189.) In examining an adult mosquito we note that there are three divisions of the body—head, thorax, and abdomen. The head shows a stout projection, called the proboscis, which contains the biting parts. In mosquitoes of medical interest this proboscis is long and straight. In males the biting parts are not strong enough to pierce the human skin; thus it is known that only the female bites. On each side of the proboscis are the palps, or sensory organs, and to the outer side of these are the antennae, or feelers. The male mosquitoes can be distinguished by the heavily feathered antennae. The thorax supports the three pairs of legs and

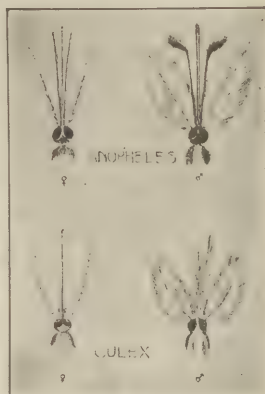


FIG. 191.—Mosquito heads showing heavily feathered male antenna and the long palps of the *Anopheles* female and the short palps of the *Culex* female. (Stitt.)

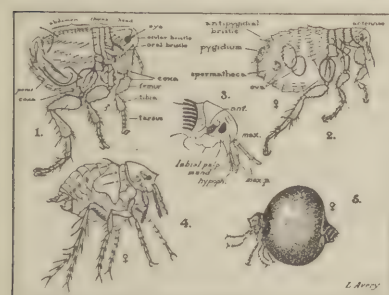


FIG. 192.—Types of fleas and jigger: 1 and 2, Male and female *Xenopsylla cheopis*; 3, head of *Ceratophyllus*; 4 and 5, male and egg-distended female of *Sarcopsylla penetrans*. (Stitt.)

one pair of wings. The wings have a characteristic arrangement of the veins and show scales. Mosquito-like insects do not have scales on their wings. The abdomen has nine segments, and on the last segment of the male are claspers.

While there are about a dozen varieties or genera of mosquitoes, we are mainly interested, from a medical standpoint, in but three of these genera, the *Anopheles*, the malaria mosquito, the *Aedes*, the yellow-fever mosquito, and the *Culex*, the filaria mosquito. To definitely differentiate these mosquitoes it is necessary to use elaborate keys and tables. But to tell whether a mosquito is a probable malaria or yellow-fever transmitter is a comparatively easy mat-

ter. The first step is to obtain a female, remembering that the antennae of the female are sparsely and not heavily feathered, as in the case of the male. The males also show claspers on tail end of abdomen. Having secured a female, note the length of the palps. (Fig. 191.) If they are as long as the proboscis and clubbed and the wings of the mosquito are spotted, it is an *Anopheles*. If the palps are not as long as the proboscis and it is a small, black mosquito

with silver or white markings on the back of its thorax, it is an *Aedes*. A mosquito with short palps, without these markings, is probably a *Culex*.

The *Pulicida* or fleas have come into prominence on account of their importance in connection with the spread of plague. In this case the transmission of the disease is mechanical, that is, by biting and depositing faecal matter containing the bacillus in the wound. The bacillus causing the disease is merely carried without change in the flea host. This is in contrast to what is known as a biological transmission such as we have in the case of malaria and yellow fever where the protozoan that causes these diseases undergoes a change in the mosquito host.

The *Pediculida* or lice are of three varieties. The one living on the head is called the *Pediculus capitis*, the one on the body the *Pediculus vestimenti*, and the one living in the hairy region about the pubis, popularly known as crab-louse, the *Phthirius pubis*. The body louse lays its eggs in the seams of the underclothing and is important on account of transmitting European relapsing fever and trench fever.

Flies.—The fly best known is the ordinary house fly *Musca domestica*. Its mouth parts are fitted for sucking and not biting. Its food must be in a liquid or semisolid state before it can be sucked up into its stomach. If it wishes to feed on any solid substance such as sugar it first pours out saliva to liquify it. Many people think that the house fly can bite, but careful examination of such a biting fly will usually show it to be the stable fly *Stomoxys calcitrans*. Perhaps the most dangerous parts of a

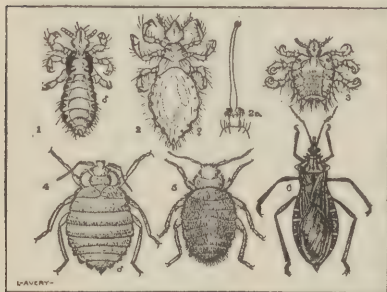


FIG. 193.—Types of lice: 1, *Pediculus capitis*; 2, *Pediculus vestimenti*; 2a, protruded rostrum of *Pediculus*; 3, *Phthirius pubis*; 4, *Acanthia lectularia*; 5, *Acanthia rotundata*; 6, *Conorhinus megistus*. (Stitt.)

fly are the pads or pulvillæ on its feet. By means of these it can carry much filth frequently containing bacteria which cause typhoid fever and other diseases.

Another important fly belonging to the same family as the house fly is the tsetse fly (*Glossina palpalis*), which transmits the *T. gambiense*, the cause of African sleeping sickness. Some flies like the flesh fly (*Sarcophaga carnaria*) can cause considerable discomfort by laying their eggs in wounds or cavities like the nose, ear, etc., their eggs developing into larvæ or maggots.

POISONOUS SNAKES.

The families of the class *Reptilia* to which poisonous snakes belong are the colubrine family (*Colubridæ*) and the viperine family (*Viperidæ*).

The *Colubrine* family includes the Florida coral snakes, sea-snakes, and cobras, the Florida and sonoran coral snakes being the only poisonous members of this family in the United States. The *Viperine* family, however, has among its members the most important poisonous snakes in America, namely, the "pit vipers" (rattlesnake, copperhead, and water moccasin).

The poisonous snakes of the United States can be distinguished by the pupil of the eye.

(A) Vertical.....	Pit present; single row of ventral scales, postanal; adult head more or less triangular and a prominent constriction behind head.	Pit vipers (all poisonous).
(B) Circular.....	Pit absent; double row of ventral scales, postanal; and— (1) Color: Yellow, black, yellow, red, in bands..... (2) Color: Black, yellow, black, red, in bands..... (3) Color: All others.....	Coral snakes (poisonous).
		False corals (not poisonous).
		Not poisonous.

Urinalysis and Blood Chemistry.¹

Two of the most important branches of medical science are blood chemistry and urinalysis. Knowledge of these subjects and the results obtained by accurate procedures in regard to technique, observation, and the recording of findings are of inestimable value in making diagnosis and indicating treatments of various diseases.

Hospital corpsmen assigned to duty in the clinical laboratory should bear in mind the necessity of careful and accurate technique in making notes, observations, and preparing records. Carelessness or errors may result in incorrect diagnosis and consequent delay in affording relief to patients.

The blood bathes all the tissues of the body. Following well-known physical and chemical laws it carries food and fuel to the cells and removes the waste products. It supplies oxygen and carries away carbon dioxide. Indirectly it helps to keep the body at a nearly constant temperature and by a beautiful mechanism, at present very little understood, it regulates the acid-base balance of the body. Moderate changes of temperature and comparatively slight changes in acidity or alkalinity may cause death. It carries *hormones* or chemical messengers, the product of the glands of internal secretion. Hormones regulate many activities of the organism and may, by their absence or increased production, cause disease. For example, diabetes mellitus is due to lack of a hormone from the pancreas, and toxic goiter is due to increased secretion of the thyroid gland. Certain of these hormones as adrenalin and thyroxin have been isolated and their chemical structure and physiological action determined.

Blood chemistry enables us to measure the amounts of a few of the substances in the blood, some of which are present in exceedingly small quantities. Methods have been developed to determine the presence of certain of these substances in concentrations as low as 1 milligram per 100 c. c. of blood. The methods can not be described here, but it is sufficient to say that several waste products such as urea, creatinine, and uric acid can be determined with accuracy. The oxygen-carrying power of the blood can be measured exactly, its reaction determined, and other analyses made which indicate probable dangerous changes in acidity or alkalinity. Some work, mostly experimental, has been done on the determination of hormones. This is a fascinating study, as yet in its infancy, and it is hoped that within a short time it will be more fully developed.

For analysis blood is collected in the usual manner from a vein in the arm. It is necessary in chemical work to prevent clotting of the blood. In order that this may be accomplished neutral potassium oxalate in the proportion of 2 milligrams for each c. c. of blood is placed in the flask in which the blood sample is to be collected. For a complete chemical analysis collect about 15 c. c. A convenient way of adding the proper amount of oxalate is as follows: Take a dropping bottle and determine how many drops it delivers to make 1 c. c. Then make a solution so that each drop represents 2.5 milligrams of potassium oxalate. Add 10 drops from the dropper to the flask to be used for collecting the blood. This is sufficient for 10-15 c. c. of blood. For example if the dropper delivered 30 drops to the c. c., 1 c. c. would contain 75 milligrams of potassium oxalate. To make up 100 c. c. weigh out accurately 7.5 grams of neutral potassium oxalate, transfer to a 100 c. c. measuring flask, and fill to the mark with water. For gas analysis collect about 8 c. c. under paraffin oil. Take a centrifuge tube, add 7 drops of the neutral potas-

¹ Prepared by Lieut. D. Corey, Medical Corps, United States Navy.

sium oxalate solution and 2 to 3 c. c. of paraffin oil. Allow the blood to flow from the needle through a glass tube, the exit of which is beneath the oil. With a small stirring rod mix the blood gently with the oxalate solution, avoiding mixing the blood with the oil. Blood analyses should be done within a few hours after collection of the sample.

Details of the procedures required in conducting blood chemistry examinations are described fully in the reference books available at any laboratory and in those listed at the end of this chapter.

The urine is an aqueous solution of organic and inorganic substances secreted and excreted by the kidneys. The substances are either waste products from the body metabolism or are products derived directly from food materials taken into the body. Some of the organic constituents are urea, uric acid, and ammonia; some of the inorganic—chlorides, phosphates, and sulphates. Certain substances appear in the urine only in pathological conditions, as proteins, sugars, acetone, bile, hæmoglobin, etc. The presence of these substances can be determined by examination, and the detection of them aids greatly in diagnosis and treatment of disease conditions. The urine also contains numerous microscopic structures.

The composition of urine varies at different hours of the day, and for this reason it is preferable to make quantitative tests upon a sample of the mixed 24-hour specimen. Qualitative tests for albumin, sugar, etc., may be made upon any specimen, not necessarily a 24-hour specimen. A 24-hour specimen of urine should be collected in a clean container and kept cool, preferably on ice, until examined. Decomposition of the urine thus is retarded or prevented. Occasionally 5 grams of boric acid to each 4 ounces of urine, or 1 drop of formalin to each 4 ounces, are used as preservatives. Larger amounts of preservatives may interfere with the reactions or cause precipitates.

Urine for examination should be clear and may be made so by filtering. Cloudiness due to the presence of bacteria may be remedied by adding a small amount of purified talc to the specimen, thoroughly shaking and filtering.

The following is suggested as a routine urine examination.

(1) *Measure the amount.*—The 24-hour specimen, normally, should be from 1,000 to 1,500 c. c., 40 to 50 ounces. This amount depends upon the quantity of fluids ingested.

(2) *Note the color.*—This varies in health and depends upon the quantity voided. The usual color is yellow or reddish-yellow. The presence of blood or bile will affect the color. A pale greenish urine suggests diabetes.

(3) *Note the transparency.*—Freshly passed urine is usually clear but upon standing becomes cloudy. Large quantities of amorphous phosphates, amorphous urates, pus, blood, and bacteria produce sediments or cloudy appearances.

(4) *Note the odor.*—An aromatic odor is due to volatile acids; ammoniacal to decomposition; fruity to acetone; and certain characteristic odors are produced by asparagus, etc.

(5) *Test for reaction.*—Acid urine turns blue litmus paper red, alkaline urine turns red litmus paper blue. If the urine is neutral in reaction, no apparent change is produced in the litmus papers. Normally urine is acid in reaction but becomes alkaline upon standing.

(6) *Test to determine the specific gravity.*—Normally this is 1.010 to 1.020. A urinometer is the most convenient means of determining the specific gravity of urine. A special container is filled with urine and a urinometer placed in the container. The urinometer should not touch the sides or bottom of

the container and should be read at the bottom of the meniscus. Diabetes causes urine to have a high specific gravity.

(7) *Test for the presence of albumin.*—The presence of albumin in the urine may indicate a transitory condition or physiological albuminuria, such as may be caused by excessive ingestion of proteins, prolonged cold baths, excessive muscular exercise in those unaccustomed to it, and to pregnancy, or to albuminuria caused by a pathological condition, as in organic changes or disease of the kidney.

In making a test for the presence of albumin it is essential that the urine be made clear either by filtration or by centrifugation. *Heat test:* Fill a clean test tube two-thirds full of clear urine. Hold the bottom of the test tube and apply heat to the upper portion of the contained urine until boiling is produced, then add 3 to 5 drops of a 5 per cent acetic acid solution and reboil. The presence of a cloud after the reboiling indicates albumin. Often a cloudy appearance, due to the presence of phosphates or carbonates, appears when the urine is first heated to boiling; this, however, disappears when acetic acid is added. Comparison between a sample of the urine and that resulting after the complete test has been made will help to show the degree of cloudiness. Roughly speaking, albumin may be reported to be present as a *slight trace* when the cloudiness is barely visible; as a *trace* when a distinct cloud is visible, and as a *heavy trace* when a heavier cloud is visible. If albumin is present to a marked degree the urine being tested may become solid. The heat test depends upon the fact that albumin is coagulated by heating.

(8) *Test for the presence of sugar.*—Transitory glycosuria is unimportant and frequently occurs after general anaesthesia, the administration of certain drugs, in pregnancy, and in head injuries. Persistent glycosuria is diagnostic of diabetes and is caused by a disturbance in the pancreas or by an injury to the floor of the fourth ventricle of the brain. *Fehling's test* consists of taking equal parts of the two Fehling's solutions, mixing together, adding 3 or 4 volumes of water and heating until boiling is produced. When this solution reaches the boiling point the urine to be tested should be added a little at a time and the solution heated but not boiled between additions. The quantity of urine added should not exceed the quantity of the reagent used. A heavy red or yellow precipitate indicates the presence of glucose (sugar). *Benedict's test:* This test is a more sensitive one than Fehling's test and gradually is replacing it. The reaction depends upon the reduction of alkaline copper solutions of glucose, forming cuprous oxide and metallic copper. In Benedict's test the alkalinity of the solution and the conditions of the test are so adjusted that very small amounts of glucose are detected and other reducing bodies present in the urine will not interfere with the reaction. Benedict's solution as described by Todd consists of:

Copper sulphate (pure crystallized)-----	gm--	17.3
Sodium or potassium citrate-----	gm--	173.0
Sodium carbonate (crystallized)-----	gm--	200.0
(Or 100 grams of the anhydrous salt.)		
Distilled water, to make-----	c. c--	1,000.0

The citrate and carbonate should be dissolved in 700 c. c. of water, heated gently, then filtered. The copper sulphate should be dissolved in 100 c. c. of water and poured slowly into the first solution, stirring constantly. The solution then should be cooled and made up to one liter. This reagent will keep indefinitely.

In making the test, take 5 c. c. of Benedict's reagent in a clear test tube, and add 8 or 10 drops (not more) of urine, using a pipette. If convenient, add a few glass beads to prevent bumping, heat to boiling and retain at that temperature for two minutes, then allow to cool slowly. If glucose is present a red, yellow, or green precipitate will be produced. Bluish precipitates, which sometimes result upon cooling, are due to the presence of urates and should be disregarded.

(9) *Examine the specimen of urine microscopically.*—Centrifuge a portion of the specimen and remove the sediment by means of a pipette. This is accomplished by inserting a clean pipette (the large end of which is closed by placing over it a dry finger tip) into the container down to and into the sediment. By carefully loosening the finger tip but not entirely removing it, a small portion of the sediment will be collected in the pipette. Replace the finger tip, remove the pipette and after wiping off the urine which adheres to the tube, allow the sediment to collect on a clean glass slide by carefully loosening the finger tip. The sediment then may be examined microscopically either uncovered or covered with a cover glass. In acid urine may be found: Uric acid crystals, amorphous urate deposits, calcium oxalate crystals, leucin, tyrosin, and cystin crystals, and fat globules; in alkaline urine: Amorphous phosphates, calcium carbonate deposits, and ammonium urate crystals.

The following organized structures may be found in urinary sediments: Tube casts, epithelial cells, bacteria, red and white blood cells, spermatozoa, and animal parasites. Details regarding the microscopical examination of urine are contained in the reference books enumerated at the end of this chapter.

If albumin or sugar are found to be present in the urine, the amounts should be determined quantitatively, as should also the amounts of urea, uric acid, creatinine, etc. These advanced laboratory procedures are described fully in the reference books available in any laboratory and in the books listed below.

REFERENCES.

- Practical Bacteriology, Bloodwork and Parasitology (seventh edition).—E. R. Stitt.
 Laboratory Manual of Biological Chemistry (third edition).—O. Fohn.
 Practical Chemical Analysis of Blood.—V. L. Myers.
 Physiological Chemistry (third edition).—A. P. Mathews.
 Diagnostic Methods—(Chemical, Bacteriological and Microscopical (sixth edition).—R. W. Webster.
 Clinical Diagnosis.—J. C. Todd.

CHAPTER XI.

SPECIAL ACTIVITIES AND INFORMATION.

Duty Independent of Medical Officers.¹

To carry out the duties with which it is charged in articles 457 and 458, Navy Regulations, the Bureau of Medicine and Surgery has trained chief pharmacist's mates and pharmacist's mates, first class, for duty as the representatives of the medical department on board vessels having crews up to 125 men, and at shore stations where the total personnel is not sufficient to warrant the assignment of a medical officer.

The vessels to which independent duty hospital corpsmen usually are assigned are destroyers, mine layers, mine sweepers, tugs, oilers, colliers, and cargo ships; the stations on shore are isolated radio stations, small detachments of marines on outpost duty, etc.

Chief pharmacist's mates or pharmacist's mates, first class, are not offered as substitutes for qualified medical officers, but rather as first-aid men who are capable of relieving the commanding officer of most, if not all, of the detailed management of the sick and injured.

Owing to the large demand and the length of time required to train men properly for this duty, difficulty is experienced in providing a sufficient number of hospital corpsmen qualified for duty independent of a medical officer. Every endeavor is made to establish and maintain a high standard of efficiency in these ratings, and only such men as are thoroughly trained and who have demonstrated their qualifications by written and practical examinations are recommended for advancement to these ratings. In view of these facts, the Bureau of Medicine and Surgery feels that the commanding officers of vessels and shore stations to which no medical officer is attached, whose experience, general education, judgment, and mental training especially fit them for the assumption of responsibility in emergencies, ordinarily may rely on these men for valuable and trained assistance in first-aid work when more skilled medical services can not be secured.

Hospital corpsmen assigned to duty independent of a medical officer and where medical officers are not available are cautioned to bear in mind the fact that the commanding officer of the ship or station is directly responsible for the proper care and disposition of the sick and injured. It is a paramount duty of a hospital corpsman so situated to make such recommendations to the commanding officer regarding the care and disposition of the sick and injured as seem advisable. These recommendations should embrace such points as obtaining the services of a medical officer or qualified medical practitioner, temporary assistance of other members of the crew, and the question of transferring patients to places or institutions where they may receive treatment which is necessary but impossible to administer at their present stations.

¹ Prepared by Chief Pharmacist N. L. Saunders, United States Navy.

Second only to the care of those actually sick or injured is the responsibility of independent-duty hospital corpsmen with regard to the application of hygienic and sanitary measures. A daily inspection of the ship or station is necessary to accomplish this, and should not be made until after all cleaning stations have been policed.

In making this daily inspection particular attention should be given to places where dirt can accumulate, such as corners, angle-irons, mess gear, mess and clothes lockers, fans, ventilators, blowers, ice boxes, vegetable lockers, wash bowls, urinals, drains, scuppers, and gratings—in fact, any place where an effort must be made to attain cleanliness. The condition of the cooking utensils, pots and pans, the galley range and the deck beneath it should be observed; the bottoms of mess tables and bunks, especially the bunk frames, should be inspected; in storerooms the stowage of unauthorized articles, such as wash buckets, swabs, dirty or wet clothes, should not be permitted, and one should be sure that the bilges of storerooms aboard ship are dry and clean. Ashore, in addition to the above, care must be exercised in the disposal of waste and garbage, the accumulation of stagnant water, drainage, protection of water containers, removal of undergrowth, manure, leaves, etc., cutting weeds and long grass, and the methods used in the disposal of human excreta.

In short, it is most important that the hospital corpsman on independent duty constantly be on the alert to observe anything and everything that in any way might be detrimental to the health and welfare of those with whom he is serving and who depend upon him for protection against disease. Dirt, filth, grease, and decayed or decaying matter are dangerous to health; all can be removed by the use of water, soap, kerosene, and "elbow grease"; and all can be prevented by careful observation and frequent inspection.

In the absence of medical officers it devolves upon the hospital corpsmen representing the medical department to inspect the food prepared for the crew, as to wholesomeness and cleanliness, the fruit and other articles of food and drink offered for sale by boats alongside, and all fresh provisions purchased for the general mess. After such inspections a report should be made to the proper officer as to the conditions found, with such recommendations as are considered necessary. There should be no hesitancy in recommending rejection or refusal of permission to sell if the inspection shows them to be unsatisfactory. Instructions governing such inspections are contained in articles 868(4), 1156, 1157, 1158, 1159, 1320, and 1324, Navy Regulations.

On duty independent of a medical officer hospital corpsmen primarily are expected to:

(a) Care for the ordinary ailments of the crew of the vessel or station to which they are attached.

(b) Administer first aid to any serious case that may occur.

(c) Maintain a sanitary supervision of the vessel or station, and make suitable recommendations to the commanding officer.

(d) Maintain a proper amount of medical supplies to meet ordinary conditions.

(e) Prepare for forwarding the necessary forms of the Bureau of Medicine and Surgery and keep the required medical records.

(f) Investigate the health conditions in ports visited or in adjacent cities and make a report to the commanding officer with such recommendations as may be deemed pertinent.

Whenever contact with medical officers is possible, independent duty hospital corpsmen should visit them for council and advice. Frequent consulta-

tion with the commanding officer is desirable. They should inform the commanding officer of any suspected contagious or infectious disease that may appear, and inform him promptly when a patient is in need of the services of a doctor. Hospital corpsmen on independent duty are expected at all times to be ready to exert themselves to the utmost to assist any person on board in need of assistance by reason of illness or injury, and, so far as may be practicable, to segregate in the sick bay or other designated place any member of the crew who is on the sick list. They are expected to calmly, quietly, and efficiently aid the commanding officer in the maintenance of the morale of the crew in the presence of disease or injury on board.

In so far as is practicable the Bureau of Medicine and Surgery does not recommend any hospital corpsman below the rating of pharmacist's mate, first class, for duty independent of a medical officer.

In adopting this policy assurance is felt that only experienced and well-qualified hospital corpsmen will be placed in positions where it is necessary for them to assume responsibility for the care and treatment of the sick and injured in the absence of a medical officer.

Because of the training, instruction, and experience of men in the Hospital Corps, especially in the upper ratings, the Bureau of Medicine and Surgery believes that many times life or limb may be saved that might, without their intelligent first-aid care, be jeopardized.

While all men assigned to this important duty probably do not feel the responsibility of their position in the same manner, the experience of many years in dealing with the problem of providing medical care and attention for small numbers of men causes the Bureau of Medicine and Surgery to be satisfied that in nearly every instance they will measure up to the high standard long required of the hospital corpsman assigned to duty as the sole representative of the medical department.

Practically every small station or vessel in the Navy is attached to or comes under the administration of some unit to which medical officers are assigned, either as district medical officers or fleet or squadron medical officers. Hospital corpsmen assigned to these stations should familiarize themselves with the local arrangements and act accordingly.

For hospital corpsmen detailed to duty independent of a medical officer the following points should be observed:

(1) If practicable, upon reporting for duty, communicate immediately with the medical officer having supervision of the medical department of the vessel or station.

(2) Accurately check the inventory of medical department property (if possible with the man being relieved) and report any discrepancies to the commanding officer and the medical officer. Do not accomplish a transfer of property unless prepared to assume responsibility for the property reported on the inventory.

(3) Hold sick call daily at some convenient hour in the morning, not later than 9 a. m., unless other arrangements have been made by the commanding officer. At this time all members of the crew who are ill or incapacitated should report or should be visited.

(4) Examine all health records and make accurate check as to whether or not the members of the crew have been vaccinated against smallpox and typhoid fever, and vaccinate immediately any who may require it.

(5) Check health records against the muster roll and assure yourself that they are complete and correct. If errors or omissions are found, correct them

at once. If any health records are missing immediate steps should be taken to obtain them or open new ones.

(6) Make daily entries in medical journal of matters concerning the medical department; prepare and forward reports and returns as required.

INDEPENDENT DUTY AFLOAT.

At sick call all cases of minor nature should be attended to. Cases requiring the attention of a medical officer should be handled as circumstances permit. All cases of injury or illness should be reported to the commanding officer. Emergency cases should be given first aid, and if serious any medical officer present should be notified at once.

Except in emergency cases that require immediate attention, the advice and services of a medical officer should be procured before transferring a patient to a hospital, and if possible the hospital corpsman should accompany patients to the hospital.

When men are brought or sent to a medical officer for physical examination prior to discharge, transfer, etc., all the necessary papers should be complete and ready for the signature of the medical officer. All these routine examinations should be taken care of during the morning hours and should not be permitted to straggle in to the medical officer at all hours of the day.

A medical journal must be kept on each vessel to which a hospital corpsman is assigned for duty. It is suggested that this be kept in a blank book, small quarto, both for convenience and economy. This journal always should be ready for inspection and should be kept in accordance with the Manual for the Medical Department.

The care of medical department property is of prime importance. Hospital corpsmen should keep medical stores in a neat and orderly manner and see that stock records are accurate and correspond with the stores. Special attention must be given to the proper safeguarding of poisons, narcotics, and alcohol. When absent the keys should be turned over to a commissioned officer.

Any stores considered to be in excess or not liable to be used or likely to deteriorate may be transferred to some other medical department activity and Form D (Transfer of Property) made out. No unnecessary stores should be requisitioned for or kept on hand. The stock should be kept as low as consistent with the nature of the duty being performed.

Damaged stores should not be destroyed or transferred but should be surveyed on board the vessel, the request for survey being made at such time as it is likely a board of survey can be appointed.

Before a hospital corpsman is discharged or transferred either temporarily or permanently from his vessel, he should make an inventory of medical department stores and prepare Form D (Transfer of Property), which should be signed by his relief. If not relieved by a hospital corpsman, the commanding officer should sign Form D. (See par. 3133, Manual of the Medical Department.) His own transfer cards should be prepared and the data necessary for the preparation of bureau forms should be left where they will be available for the successor.

No patient should be transferred to a hospital (except in emergency) without first having been seen and examined by a medical officer. Hospital tickets and health records ordinarily should be signed by the medical officer making the transfer. Hospital corpsmen on independent duty when within reach of a medical officer are not expected to make routine transfers of patients to hospitals. When patients are transferred to a hospital, they should be accompanied by all necessary papers, including transfer pay accounts and service

records, and personal baggage. A letter requesting a man's return to a vessel when ready for duty should be sent to the hospital at the time of transfer, if his return is desired by the commanding officer.

Emergency or contagious cases may be transferred to a hospital at any time regardless of the preceding statements, which apply mainly to ordinary cases.

Patients requiring treatments or examinations in hospitals, such as refraction, blood tests, X-ray, etc., should be sent to the hospital only on such days as are set apart for these examinations.

Medical department reports and returns are to be prepared and signed by the hospital corpsman on independent duty and forwarded through official channels. All reports should be made promptly and not left until the last. Monthly reports should be made out as soon as possible after the end of the month, and others as directed. Care must be taken to see that copies as required by fleet and other regulations are sent out.

Correctness, neatness, and promptness are essentials in preparing reports. A slight amount of care and thought expended on these forms saves considerable labor if the report goes through without having to be returned for correction. No efficient and painstaking hospital corpsman ever should have to have his forms corrected.

Care should be exercised to see that—

(a) On requisition Form 4, on surveys, on inventories, and on transfers of property the items listed appear under their respective classification headings as given in the Supply Table.

(b) On Form Ca (surveys) the quantities must be shown in numerals and not merely marked "X." In the case of items listed as "missing" a signed footnote as to the responsibility for the loss should appear on the face of the report. When items are missing from a pocket case, venereal case, or other composite article the individual items from these cases must be listed instead of the complete unit.

Example:

Case, pocket; items from—

1. _____	Bistoury, straight_____	No. 1
2. _____	Scissors, straight _____	No. 1
3. _____	Tenotome _____	No. 1

(c) On Form F (rough) and Form F (smooth) the diagnosis always should be precisely as given in the nomenclature of diseases. That pamphlet or the Manual of the Medical Department should be consulted freely so as to get the exact arrangement of words and correct spelling, the key letter, diagnosis number, etc. "Undetermined" never must be used without the word "diagnosis." When the entry is for an injury, do not forget to enter the location, causative agent and key letter, and the specialty letter when it is required.

(d) On Form K, or Form F revised, be sure that the "Taken up" column corresponds with the "Disposition" column, also that the number of cases corresponds with the number reported on Form F.

When supplies are needed they usually may be obtained from any vessel near, a naval hospital, or a naval dispensary upon request, but regular submission of requisitions for supplies on the medical supply depot should be made.

The foregoing information has been general and is for the use of all hospital corpsmen on independent duty. That which follows is applicable more especially to hospital corpsmen serving on destroyers and outlines the general routine and instructions to be expected in destroyer squadrons. It is based upon

the system of organization used in the destroyer squadrons operating in Atlantic waters as developed by the destroyer squadrons' medical officer in 1921.

The *destroyer squadrons' medical officer* is the medical aid to the destroyer squadrons' commander, and has direct supervision of all medical department activities in the destroyer squadrons. He is assigned quarters and has his office on board the flagship of the destroyer squadrons.

In addition to duties similar to those of a fleet surgeon, as described in the Manual of the Medical Department, he supervises the assignment of medical officers and hospital corpsmen, making recommendations to the personnel officer on the staff of the commander.

He prepares for the signature of the chief of staff a monthly schedule of vessels having medical guard duty and makes changes in this schedule when the necessity arises. He prepares a weekly prophylactic duty schedule for chief pharmacist's mates and pharmacist's mates, first class, on independent duty, and monthly for tenders and the flagship for hospital corpsmen of lower ratings.

He supervises requests from destroyers for medical stores that are to be supplied from tenders.

At any time he may make unofficial inspections of vessels in company with the squadron medical officer.

A chief pharmacist usually is assigned as his assistant when all divisions of the destroyer squadrons are in active commission.

Squadron medical officers.—A medical officer is assigned to each squadron of the 50 per cent complement vessels, and for each division of the operative squadron.

The squadron commander may order the squadron medical officer to report to any vessel within the squadron for the assignment of quarters. Usually he is quartered on board the squadron flag boat.

The best conception of the duties of the squadron medical officer is to consider the squadron as a unit and each vessel as an integral part of that unit. His activities must not in any way be confined to the vessel on which he is quartered. He has charge of the medical department personnel within the squadron as well as the usual matters pertaining to health and sanitation as defined in the Navy Regulations and manuals. He receives orders from the squadron commander and makes his recommendations to him. He may make recommendations also to the commanding officers of destroyers.

His relation to destroyer officers corresponds to that of a medical officer and division officers on board a larger vessel. A courteous and harmonious relationship should be maintained with commanding officers and other destroyer officers and no occasion should be given for assumption or usurpation of authority rightfully belonging elsewhere. No visit of an unofficial nature should be made to a vessel, except to visit the sick, without reporting to the commanding officer of the vessel upon arrival on board.

The squadron medical officer holds daily sick call on board the vessel on which he is quartered, at a convenient hour in the morning but not later than 9 o'clock. The hour for sick call should be published to the squadron and strictly adhered to. Patients from all vessels in the squadron requiring attention and not too ill to bear the transportation should report to the medical officer at this time. Health records should accompany patients. After the regular sick call the medical officer visits all nonambulant sick. Nonambulant patients should not be kept aboard destroyers but should be sent to a tender for treatment or transferred to a hospital.

The squadron medical officer should make frequent (unofficial) sanitary inspections of the destroyers and assure himself that vessels are being kept up to standard, and invite the attention of the commanding officer of the

vessel visited to such recommendations as he wishes to make. These recommendations should be incorporated in his semimonthly report of sanitary conditions to the squadron commander. On these inspections especial attention should be paid to the sick bay and medical storeroom, assuring himself that stock records are being kept, that economy is being used in the issue of stores, that stores are properly stowed and that means are taken for their security in the absence of the hospital corpsman. He should see that narcotics, alcohol, and poisons are under lock and key or otherwise properly safeguarded, and that health records and other records are being properly written up, are complete and filed in a safe place in a careful manner.

He should personally see that all personnel have been safeguarded against smallpox and typhoid fever and that appropriate entries have been made in their health records.

He should make arrangements to carry out monthly venereal inspections in which the hospital corpsmen should assist.

The squadron medical officer through the squadron commander has authority to move or transfer hospital corpsmen within the squadron. All hospital corpsmen originally assigned to duty in a squadron by the destroyer squadrons' commander are ordered to report to the squadron commander for such duty as he may assign or for some particular duty. Further changes within the squadron are made by the squadron commander.

When the vessel to which the squadron medical officer or a hospital corpsman is attached is to lay up or be absent from squadron for a long or indefinite period he should request the squadron commander for change of duty to an active boat so that his services will not be lost to the squadron.

When a squadron medical officer goes on and returns from leave he should inform the destroyer squadrons' medical officer by memorandum so that details to boards, medical guard, and other duties will not be interfered with.

Hospital corpsmen of the ratings of chief pharmacist's mate and pharmacist's mate, first class (see Bureau of Navigation Manual, Arts. D-6162-63-64), usually are assigned to independent duty on board a destroyer. In addition to his duties on board the vessel to which he is attached, when several destroyers are tied up to one buoy, a hospital corpsman may be the medical department representative on board the other destroyers at his buoy, and as such should hold himself responsible for medical department reports and returns from these vessels and for the upkeep of storerooms and other medical department activities, just as if it were the vessel to which he is attached. If more than one hospital corpsman is at a buoy, this additional duty is assigned by the squadron medical officer.

Under the direction of the squadron medical officer, an examination of the crew of the vessel for communicable and venereal disease should be made at least once each month. A daily sanitary inspection of vessels and report of findings to the respective commanding officers concerned should be made. These inspections may be supplemented by making a memorandum report on sanitary conditions to the squadron medical officer, either verbally or written. If written, it should be forwarded via the commanding officer.

The squadron medical officer is the proper officer to handle all cases of illness and all physical examinations of the men in the squadron. No men should be sent to tenders for these purposes except on recommendation of the squadron medical officer and then only for such examination as is beyond his scope on board destroyers.

In the absence of the squadron medical officer, the guard medical officer acts. In an emergency, any medical officer may be called, or any man manifestly in need of emergency medical assistance may be sent to the tenders.

In any event, medical assistance will not be refused by any medical officer.

Reports and returns from vessels to which no hospital corpsman is attached should be prepared by the hospital corpsman at the same buoy or by a hospital corpsman designated by the squadron medical officer.

The letter in lieu of reports should be submitted only when the vessel without a hospital corpsman on board is absent from the buoy or base or is not in touch with any representative of the medical department. A hospital corpsman usually is assigned to repair groups at navy yards and is expected to make all routine reports and returns from the vessels in the repair group.

Reports and returns should be routed through the squadron medical officer, who verifies and places his initials near the signature line and forwards them to the proper destination. Convenience demands that all papers from a squadron be sent in at the same time. Corrections should be made by the squadron medical officer, returning them to the sender if necessary. During the absence of destroyers from the base or in the absence of the squadron medical officer, reports may be sent direct from the vessel to destination.

There usually are unofficial reports required from destroyers and as a rule these will be:

(a) Semimonthly report to squadron commander on sanitary conditions of vessels of squadron. This report is intended to show to squadron commanders the current sanitary condition of all vessels as viewed on the frequent inspections of the squadron medical officer. In this report the vessels visited should be mentioned by name.

(b) A semimonthly list (1st, and 15th, of month) submitted to the destroyer squadrons' medical officer, showing the distribution and changes in hospital corpsmen of the squadron. Each man is listed with full name, rate, ship, and buoy to which attached and date of expiration of enlistment. This is in addition to the usual transfer cards, which always shall be prepared in accordance with paragraph 403, Manual for the Medical Department, immediately in cases of arrivals, departures, promotions, discharges, desertions, etc., and forwarded to the Bureau of Medicine and Surgery.

(c) Each day a signal is sent by the squadron medical officer to the vessels of the squadron, giving the name of the vessel of the force having the medical guard duty. Squadron medical officers also keep the hospital corpsmen of the squadron advised regarding medical guard ships.

Destroyer tenders act as supply ships for the destroyers and make requisitions on the Naval Medical Supply Depot accordingly. They fill authorized requests for medical stores from destroyers.

As a routine procedure, destroyers make requests on their tenders through the squadron medical officer, but if nonexpendable articles are required, through the destroyer squadrons' medical officer.

The squadron medical officer carefully scrutinizes these requests and eliminates items or decreases the amounts considered in excess or may disapprove the entire request if deemed advisable.

The tender that will supply the stores requested is designated by the destroyer squadrons' medical officer.

Official requisitions on the Naval Medical Supply Depot should be submitted only when the articles desired can not be procured from the tenders and should be signed or initialed by the squadron medical officer when present.

and accompanied by a letter signed by him stating that the articles desired are not procurable from stores on the tenders.

SPECIMEN FORMS FOR LETTER REPORTS.

(Sample letter in lieu of reports.)

U. S. S. _____
Place _____
Date _____

From: Commanding officer.

To: Chief of the Bureau of Medicine and Surgery.

Subject: Letter in lieu of medical department reports and returns for month ended _____

1. There is no medical officer or hospital corpsman attached to this vessel.

2. The sick of this vessel were treated during the month on the U. S. S. _____
(or at the United States naval station, yard, or hospital) at _____

3. Complement (number of officers and men on board). Total _____

(Signature.)

(Sample monthly report of communicable diseases.)

U. S. S. _____
Place _____
Date _____

From: Medical officer.

To: Chief of the Bureau of Medicine and Surgery.

Via: Commanding officer.

Subject: Report of communicable diseases and other data for the month ended _____

[Only original admissions.]

1. Class VIII—		4. Class XI—	
Cerebrospinal fever _____	1	"None."	
Influenza _____	12	5. Class XII—	
etc., as they occur or state		Chancroid _____	4
"None."		Gon. inf. Urethra _____	2
2. Class IX—		Gon. inf. Epid _____	1
"None."		Syphilis _____	4
3. Class X—		6. Class XIII—	
Malaria _____	1	"None."	
7. Number of admissions (including above) for all diseases _____			
8. Number of admissions for injuries and poisons _____			
9. Total all causes (Items 7 plus 8) _____			
10. Complement (number of officers and men on board) _____			

(Signature.)

Duty with the Ship's Landing Force and on Shore Patrol.¹

WITH THE SHIP'S LANDING FORCE.

A permanently organized landing force, consisting of infantry, artillery, and other auxiliary units, is maintained on each ship, and is known as the ship's battalion. It varies in size and composition according to the type of ship. For a ship of the first rate it consists normally of one company of marines, two companies of bluejacket infantry, one company of bluejacket artillery, the battalion commander and staff, and certain special details, such as the pioneers, signalmen, cooks and messmen, the ambulance party, and officers' servants.

The ambulance party, which is commanded by the battalion surgeon, usually the junior medical officer of the ship, is composed ordinarily of two litter bearers from the line of each company, or, preferably, an equal number from the ship's engineering divisions, with a chief pharmacist's mate and as

¹ Prepared by Lieut. Commander W. M. Kerr, Medical Corps, United States Navy.

many hospital corpsmen of the lower ratings as the circumstances may demand. During an engagement, in order to reduce the number of ineffective men to a minimum, messmen, orderlies, and others not actually engaged in their own legitimate duties are, when practicable, employed to reinforce the litter bearers. They should recover the arms and ammunition of disabled men, assist in carrying the wounded, and perform such other duties as the battalion surgeon may direct.

The equipment of the ambulance party depends largely upon the nature of the battalion's duty on shore. Ordinarily the litter bearers and hospital corpsmen carry no weapons, but wear the Geneva cross on the left arm. Men detailed to assist the litter bearers should lay aside their arms and wear the Geneva-cross brassard. Against a savage or uncivilized enemy, however, the men of the ambulance party carry pistols and omit the brassard.

The battalion may be assembled for landing either fully or lightly equipped.

When fully equipped each member of the ambulance party wears the uniform prescribed and carries a pack carrier (packed), haversack, rubber blanket (poncho), cartridge belt, filled canteen, and leggings. There is no provision for carrying the overcoat on the pack. When weather conditions make it necessary to carry the overcoat it has to be worn.

The haversack contains rations, knife, fork, spoon, meat can, bacon can, and condiment can; also a towel, soap, comb, toothbrush, tooth powder or paste, sewing kit, matches and tobacco and pipe, if desired. The poncho is folded to suitable size and carried in the haversack on top of the rations.

The pack carrier when completely assembled should contain one-half of a shelter tent with the accompanying tent pins and pole, a blanket, one pair of trousers and one jumper, one pair of drawers and one undershirt, two pairs of socks, a white hat and a comfortable pair of high shoes.

When pack carriers are not provided, the most necessary of the above-mentioned articles are carried in the blanket neatly rolled lengthwise, covered with the poncho and stopped with clothes stops, the roll placed over the left shoulder with both ends of the roll secured together under the right arm.

When the battalion is lightly equipped the men carry filled canteens and cartridge belt and wear leggings. The blanket and poncho or the pack carrier with haversack may be prescribed if circumstances require it.

The special equipment of the ambulance party is as follows:

- (a) One litter for each two bearers.
- (b) A Geneva-cross brassard for each man.
- (c) A Hospital Corps pouch for each hospital corpsman (large for chief pharmacist's mate; small for others).
- (d) A Geneva-cross flag on a staff.

The expeditionary medical and surgical chests and the medical emergency boat boxes are available for use with the landing force.

Ample preparations will be made by the battalion surgeon for an additional supply of instruments, dressings, and other equipment for an expedition in accordance with the length and character of the service and he invariably will make an inspection of all equipment prior to embarkation to see that medicines, instruments, dressings, and the men's clothing are ample and in proper condition.

Each member of the ambulance party should wear his identification tag attached to the neck.

Frequently, at sea or in port, the ship's battalion is formed for inspection or drill. The ambulance party assembles at a place on deck designated in the

ship's organization scheme. Members of the party should report promptly in clean uniform and with the equipment specified. The party is mustered by the chief pharmacist's mate, who reports the result of the muster to the battalion surgeon, who in turn makes a report to the battalion adjutant. When the battalion surgeon is away from the ambulance party's place of assembly, the party is in charge of the chief pharmacist's mate, who should see that the men keep in formation, and refrain from loud talking or other disorder.

If the battalion is formed for inspection of the equipment, the pack carriers are unstrapped, the packs removed, unrolled and arranged as explained in the Hospital Corps Drill Book.

The occasion often is used as a period of instruction, during which the battalion surgeon, the chief pharmacist's mate, or other members of the Hospital Corps may exercise the litter bearers in various methods of controlling hemorrhage, applying occlusive dressings to wounds, splinting fractures, and transporting the wounded.

When the battalion is to leave the ship, the ambulance party may, for the purposes of landing, be split up and detailed to the various boats making the landing, or it may be landed as a unit in a hospital boat which shall carry no arms whatever, and shall carry a Geneva-cross flag on a staff in the bow, except when operating against an uncivilized enemy.

On landing, the ship's battalion may join battalions from other ships to form a regiment, which in turn may be associated with other regiments to form a brigade. Both the regiment and brigade have a medical organization, which is outlined in the Manual of the Medical Department, United States Navy. Ordinarily the ambulance party of each battalion will operate with that battalion. If the battalion goes into camp, the ambulance party is concerned with the care of the sick and the sanitation of the camp site. Record of all patients treated must be made. Loose leaves from health records, Form F (cards) and diagnosis tags will be, ordinarily, the only material needed in a landing force for keeping these records. Upon return to the ship the medical entries should be inserted in the proper health records.

Should the battalion participate in an engagement the battalion surgeon will establish an aid post in a sheltered spot as near as possible to the firing line. From this station the litter bearers, under the direction of hospital corpsmen, will make their way to the firing line, apply first-aid treatment, administer anodynes and restoratives, and, when opportunity is afforded, return with the seriously wounded to the station where the battalion surgeon and his assistants may institute further treatment and arrange for their transportation to the rear.

The ship's battalion sometimes is landed for parades or reviews. On these occasions the ambulance party follows the battalion, each litter being carried by four bearers, the litters being horizontal and carried abreast of each other. It is landed not simply for parade, but to administer first-aid treatment in cases of sunstroke, accident, or sickness.

ON SHORE PATROL.

Whenever a fleet or vessels of the United States Navy visit a United States or foreign port it is customary to land a body of sailors known as the shore patrol. The purpose of this patrol is to preserve order among the men who are ashore on liberty and to enforce whatever regulations concerning the port the senior officer present may issue. A medical officer and some hospital corpsmen

usually are detailed for duty with the shore patrol and become an integral part of it. The duty of the medical detachment of a shore patrol is to render emergency medical and surgical treatment to men ashore on liberty from the vessels present and to members of the shore patrol who may be injured or become ill.

The ease with which this duty may be performed depends greatly upon the nature of the port in which liberty is granted. In a well-organized community possessing an efficient police force, public hospitals and ample facilities for handling large liberty parties, such as are found in any well-organized municipality, the problem is easy to solve. But in cities having few attractions for the men, no welfare activities, numerous liquor stores, houses of prostitution, and an inefficient police force the problem presents a different aspect. It is a port of this type which will be considered in the present article, when visited by a fleet.

The personnel of the medical detachment of the shore patrol should consist of one medical officer and four well-trained, reliable pharmacist's mates. Each man should carry ashore with him his field equipment, viz., a poncho, belt and canteen, extra shoes and leggings, a change of underwear and socks, an extra suit of whites or blues, hammock, mattress, cot, two blankets, mosquito net, necessary toilet articles, two towels, shoeblacking, a notebook, and pencil or fountain pen. The detachment should have a bucket for water, a washbasin, and a supply of toilet paper.

In many ports the members of the shore patrol will be quartered in a hotel, or in a comfortable military barracks or in a police station, but one never knows what is ahead of him when liberty is given in a strange port, so each pharmacist's mate detailed to duty with the shore patrol should go ashore prepared to camp out in whatever quarters are available. He may find himself lodged in an empty warehouse or in the baggage room of a railway station.

Before leaving the ship it is necessary to assemble certain material for use in connection with the treatment of sick or injured among the liberty party. As conditions ashore are more or less unknown a fairly complete field equipment will be necessary, in which must be the following:

1. A Geneva-cross flag and staff to mark the main dressing station.
2. The medical and surgical expeditionary cases.
3. A mess table upon which to place the expeditionary cases and other appliances at the main dressing station.
4. Three folding cots.
5. Three pillows with pillowcases.
6. Three blankets.
7. Two Stoke's splint stretchers, each having a pillow and two blankets. It is advisable to place a tag bearing the name of the ship on each of these stretchers and on each blanket as they may be used for the transportation of men to the hospital ship and easily become lost unless tagged.
8. Two buckets for water.
9. Four washbasins (two for main dressing station and two for early-treatment station).
10. Five hundred c. c. Tr. Iodine.
11. An ample supply of sterile dressings and bandages. Materials to make tincture of iodine and compressed dressing material are to be found in the expeditionary cases, but it is better to use a freshly sterilized supply of dressings and to disturb the cases as little as possible as it might be impossible to renew supplies used from them for some time.

12. A blank book to be used for a journal in which is to be entered an account of all the detachment's activities, especially notes of all cases treated and examinations made.

13. A package of shipping tags.

14. Material for early venereal treatment and report blanks which when filled out are sent to the medical officer of the applicant's ship.

The quarters for the shore patrol generally are selected by an officer of the train, which usually arrives in advance of the fleet. Therefore when the patrol party lands, it is marched at once with its equipment to the quarters selected. It is a good rule in Navy life never to become separated from one's baggage, so on this march from the dock to the quarters see that all the medical department equipment is brought along and none left on the dock. Most of the material brought ashore can be packed in the two splint stretchers and carried safely with the aid of men from the patrol, who will be detailed by the senior patrol officer on request.

Having arrived at the patrol quarters, the sleeping accommodations for the pharmacist's mates are arranged for. These probably will be with the rest of the patrol, and the comfort each man gets depends upon his adaptability for service in the field. Next comes the question of food. In some ports the shore patrol will be subsisted from some vessel and the cooked food sent ashore. Usually, however, each man's ration is commuted and he is allowed not more than 75 cents for each meal. A survey of the neighborhood will reveal the best eating places. Remember that no member of a shore patrol is permitted to drink any alcoholic beverage while on duty.

The next step is to establish the main dressing station, where seriously injured men may be brought for first-aid treatment. This station should be as near the landing place as possible and should be marked by the Geneva-cross flag. Having secured a suitable location, set up the three cots and the mess table, upon which place the expeditionary cases and two of the wash basins, together with other dressing material. This table will be found very useful as a dressing stand. Secure a supply of fresh water and make up whatever antiseptic hand solution the medical officer uses, covering it with a clean towel. The splint stretchers should be prepared for use and placed out of the way. One pharmacist's mate is detailed to care for the main dressing station.

The prophylactic or, more properly speaking, the venereal early-treatment station likewise should be established near the landing place and if possible adjacent to the main dressing station. Experience has shown that these two stations should not be combined, because if there is opportunity for much exposure to venereal disease in the port it is likely that a large crowd of noisy men will visit the early-treatment station and if the dressing station be in the same place its proper functioning will be interfered with. This station must be in charge of one pharmacist's mate, who will prepare and supervise the treatment and fill out the treatment report blanks. He should be assisted by at least two members of the shore patrol, whose duty is to preserve order. The early treatment of venereal disease is most important and must be faithfully and conscientiously carried out. It is not agreeable duty, as the patients often are under the influence of liquor, foul-mouthed, and disorderly, but if venereal disease is prevented by the treatment it is worth all the effort expended.

A dressing station equipped with a Hospital Corps pouch and a supply of sterile dressings, iodine, and bandages, and in charge of one pharmacist's mate should be established at the landing place, as it is to be expected that many men will present themselves with minor wounds which require sterilizing and dressing before embarking for their ships. All cases of serious injury, such

as fractures, severe hæmorrhage, large lacerated wounds, etc., appearing at this station should be sent to the main dressing station for treatment because at the landing there will be more or less confusion caused by embarking men, many of whom may be intoxicated.

At the landing place a space should be reserved for the reception of severely intoxicated men. This space should be so located as to safeguard the men placed in it. Many of these men will be unconscious or semiconscious, others will be noisy or talkative, while others will be fighting drunk. If these men be permitted to wander about at will there is danger of their falling off the dock into the water or onto the landing float. The space selected for the retention of drunken men should be in charge of a competent chief petty officer of the shore patrol. He should have sufficient assistants to preserve order.

The fourth pharmacist's mate should act as relief for meals and as assistant to the medical officer. Experience has shown that none of the stations mentioned above should be left unmanned while the liberty party is ashore. One never knows when a serious accident will happen. A man may be run over by a trolley car or shot or stabbed at any time. Liberty in a port such as we are discussing generally begins at noon and expires at 8 p. m., but it probably will be 11:30 before the dock is cleared of the last stragglers, and until all of the liberty party has embarked the medical detachment must keep their dressing stations open because the patrol in their final search of the streets for the night may find some men injured or unconscious.

As soon as possible after landing the medical officer of the shore patrol should make a sanitary survey of the port. This survey should include an investigation of the food and water supply of the port, the diseases prevalent, and the neighborhoods harboring contagious diseases or houses of prostitution. With the information so gained through the cooperation of the senior patrol officer he should prevent as much as possible the exposure of the liberty party to disease by suitable recommendation for the restriction of infected localities.

There are several special points relating to the activities of the medical department which are well to bear in mind. Frequently men are brought down to the landing place profoundly intoxicated and often unconscious. Each of them should be examined carefully by the medical officer, as the unconsciousness may be due to a head injury which necessitates immediate transportation to the hospital ship. An attempt should be made to identify every unconscious man. Examination often will show that he has no identification tag and his clothing will bear several names; therefore it becomes necessary to learn his name and the name of his ship from his shipmates who may be around. Write this information on a shipping tag and tie it securely to his clothing, then have him placed in the space reserved for intoxicated men. This will facilitate his return to his ship. Men will be brought to the medical officer for examination to determine whether they are under the influence of liquor. If the man is found under the influence of liquor, careful notes should be made in a notebook kept for this purpose of all the details of the case—the man's name, his rate, his ship, peculiarities, or marks by which he may be identified, and the signs or symptoms upon which the decision that he is intoxicated is made. Then get some officer or chief petty officer from his ship to identify him and record that officer's name for future reference. All this is necessary, because men often give wrong names and have no identification tag or proper marks upon their clothing, and the medical officer in all probability will be called as a witness by a court-martial in the case weeks after, and unless he has kept a very clear record of each case and has the identity of each man pronounced under the influence of liquor clearly in mind he will not be able to give clear testimony in court.

Men seriously injured may be expected at the main dressing station at any time, and provisions for their care always must be in readiness. Great care must be taken to identify each badly injured man and to place upon him a tag bearing his name, rate, and the name of his ship. All severely injured men after having been given the necessary first-aid treatment should be sent immediately to the hospital ship, where there are medical officers always on duty. If an injured man should be sent to his own ship, it is possible that the medical officers of that vessel might be ashore and the professional attention required would be lacking. Severely injured men are best transported in the splint stretcher, and may be sent to the hospital ship in either a patrol boat or a liberty boat, which may be diverted from its regular duty by order of the senior patrol officer. When an injured man is sent to the hospital ship a member of the medical detachment should accompany him to care for him en route and to insure the prompt return of the stretcher to the dressing station.

Duty with Marine Corps Expeditionary Forces.¹

The hospital corpsman serving with Marines has many and varied duties. He becomes primarily a soldier and may be detailed with the medical detachment of the combat units; as a nurse in the hospital company of the medical battalion; a clerk in the administrative section; a litter bearer in the sanitary company; or as an ambulance driver in the ambulance company. He must be physically robust and capable of quickly adapting himself to all the conditions of a soldier's life.

The act of August 29, 1916, provides, in part, as follows: "Officers and enlisted men of the Medical Department of the Navy, serving with a body of Marines detached for service with the Army in accordance with the provisions of section sixteen hundred and twenty-one of the Revised Statutes, shall, while so serving, be subject to the rules and articles of war prescribed for the government of the Army in the same manner as the officers and men of the Marine Corps while so serving."

The responsibility and functions of the medical department with marines may be summarized as: The conservation of the fighting strength of the force.

This is accomplished by:

- (a) Supervision of sanitation and hygiene.
- (b) Prevention of epidemics.
- (c) Management of epidemics when they occur.
- (d) Collection, evacuation, hospitalization of sick, injured, and wounded.
- (e) Prompt return of sick and wounded to their organization, and elimination of the permanently unfit.
- (f) Procurement, storage, and distribution of medical supplies.

The medical department of a Marine Corps post is organized as follows:

1. An administrative headquarters, or post surgeon's office with the following duties:

- (a) Coordination of all the medical activities.
- (b) Preparation and forwarding of all medical department reports and returns.
- (c) Preservation of medical department files.
- (d) Procurement, stowage, and issue of medical supplies.

¹ Prepared by Lieut. Commander W. Chambers, Medical Corps, United States Navy.

The post surgeon is the advisor to the commanding general on all matters pertaining to sanitation and the health of the post. He is the commanding officer of all the medical department personnel of the station.

2. The sanitary inspector has the following duties:

(A) Supervision of the sanitation of the post.

(B) Preparation of data and charts relative to:

(a) Sick rate.

(b) Incidence of venereal disease.

(c) Epidemics.

(d) Sanitary work contemplated or undertaken.

(e) Disease carriers.

(f) Food.

(g) Water.

(h) Epidemiology.

(C) Maintenance of contact with local civil health authorities.

3. Dispensaries maintained in each regimental area with a medical officer in charge who is responsible for the sanitation of that area; keeps health records of regimental personnel; provides temporary care of sick and injured; instructs his subordinates in first aid; advises the regimental commander on matters pertaining to sanitation of the regimental area and on matters affecting the health of the organization; instructs the regimental personnel in personal hygiene and first aid.

4. A sick quarters maintained to furnish hospital treatment for the sick and injured and similar to a naval hospital in organization.

ORGANIZATION OF MEDICAL DEPARTMENT WITH A MARINE EXPEDITIONARY FORCE OF ABOUT THE STRENGTH OF ONE INFANTRY BRIGADE WITH ATTACHED ARTILLERY, ENGINEER, AIR SERVICE, AND OTHER SPECIAL TROOPS.

The whole medical department is under the control of the force surgeon who is responsible for the sanitation of the occupied area; the collection, evacuation, and hospitalization of all sick and wounded; preparation of reports, records, and returns; procurement, storage, and distribution of medical and surgical stores; training and coordination of all the medical units of the force.

For convenience the organization may be shown by briefly considering the various medical units from the front to the rear beginning with that of the infantry regiment. (Fig. 194.)

The medical detachment of an infantry regiment is composed of a regimental surgeon with sufficient junior medical officers to allow at least one for each battalion and the headquarters detachment, and a group of hospital corpsmen sufficient in number to allow its subdivision into four smaller groups for duty with the above-mentioned units of a regiment. Each battalion group again is divided for duty as first-aid men, litter bearers, and aid-station men.

In combat this detachment furnishes first aid to, and transportation to aid stations for the wounded, and provides for their temporary care until they can be evacuated to hospitals. With this object in view, aid stations usually are established behind each battalion and at regimental headquarters. The hospital corpsmen serving as first-aid men go forward with their companies and apply first-aid dressings to the wounded. If the whole force is advancing rapidly, the aid stations are not established until the situation becomes somewhat more stationary, and the wounded who have been given first aid are left in groups to be evacuated by other medical units following.

After the first-aid man has completed his initial task of applying first aid, he directs the slightly wounded to the aid stations and the litter bearers transport the nonambulant cases.

At the aid stations they are given stimulating food and drink, fractures are immobilized, hæmorrhage arrested, and those going to the hospitals are properly sorted and marked, while trivial cases are returned to their units at the front.

The aid stations are established as close to the front as the situation permits, taking advantage of any available shelter from rifle and artillery fire, such as

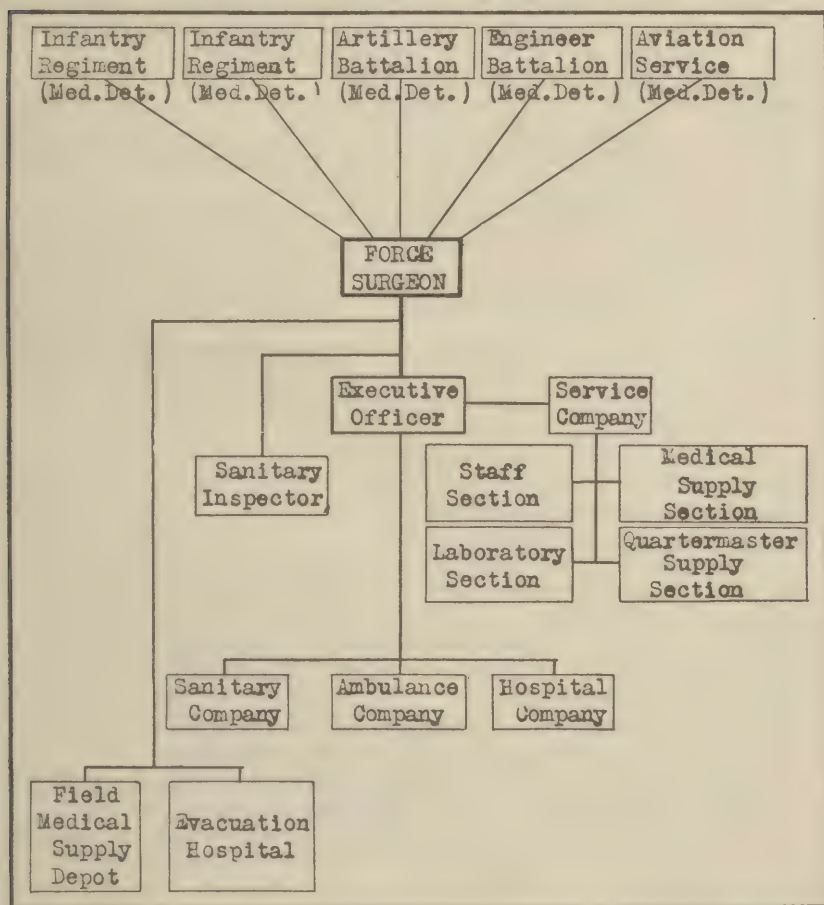


FIG. 194.—Organization of medical department for one infantry brigade, Marine Corps Expeditionary Force.

dugouts, ravines, and deserted cellars. These places of course should be avoided in the presence of enemy gas.

As the functions of the regimental medical detachment require it to keep close contact with its regiment it must keep as clear of wounded as possible at all times.

The medical detachment of a regiment furnishes small groups of hospital corpsmen for detachments of their regiments when they are serving as advance,

flank, or rear guards, or on other detached duty. Their duties are similar to those described above.

During combat the regimental detachment covers the whole area occupied by its organization, from the aid station forward to the battle line. It is essential that all its activities be confined to this area and that its efforts be coordinated by the regimental surgeon, who is informed from time to time by runners or other means of communication from the battalion aid station, of any change in their location. The regimental surgeon keeps contact with the medical units in his rear by means of litter bearers from the collecting stations, by runners, or through his regimental post of command. Routes to aid stations may be shown by some means such as hanging pieces of bandage at intervals along the route. Their location should be shown to those in the rear by indicating their map position.

Dispensary service is established in the regiment when not in combat.

Behind the regimental medical detachment is the medical battalion, which consists of a headquarters; a service company; a sanitary company; an ambulance company; and a hospital company.

In a general way its functions may be defined as the coordinating center of medical correspondence of the whole force; keeping records; requisitioning for medical and quartermaster supplies, and distribution of the same. Its chief function, however, is the collection, evacuation, and temporary hospitalization of the sick and wounded.

The service company is divided into four sections, known as the staff section (correspondence and preservation of records); the medical supply section; the quartermaster supply section; and the laboratory section.

The sanitary company with the two remaining companies form the relay for evacuation of all sick and wounded from front to rear by establishing collecting stations, ambulance stations, and hospital stations. It is divided into two or more sections and each of these in turn is subdivided into a litter-bearer group and a collecting-station group. (See Fig. 195.)

In combat the collecting-station group establishes a collecting station at a point giving protection from enemy fire, which should be as near to the regimental and battalion-aid stations as possible. This station should be equipped with surgical dressings in abundance, medicines, hot food, and water for the wounded. Its function is to sort the wounded, reapply dressings if necessary, and prevent shock.

When the collecting station is established the litter-bearer group brings in the wounded from the regimental and battalion aid stations.

On the march, when not in the presence of an enemy, collecting stations are established along the route to provide temporary shelter for men falling out from illness or injury. These stations are evacuated by the ambulance company following the troops and the casualties are carried to the camp-hospital station.

The sanitary company supervises the sanitation of the whole area in camp.

The ambulance company establishes the ambulance station (Fig. 195) ordinarily about midway between the collecting station and the hospital station. It is merely a control point, which, when established, sends forward one or two ambulances to carry the nonwalking wounded from the collecting station to the hospital station, and then returns to the ambulance station. When loaded ambulances pass the ambulance station on their way to the rear, others from this control center are sent forward to replace them by the regulating officer. Treatment of the wounded ordinarily is not attempted between the collecting station and the ambulance station.

On the march units of the ambulance company follow the marching troops, pick up casualties, and evacuate the collecting stations previously established along the route.

The hospital company is a relatively lightly equipped hospital, capable of free movement in the field, and establishes a hospital station to the rear of the

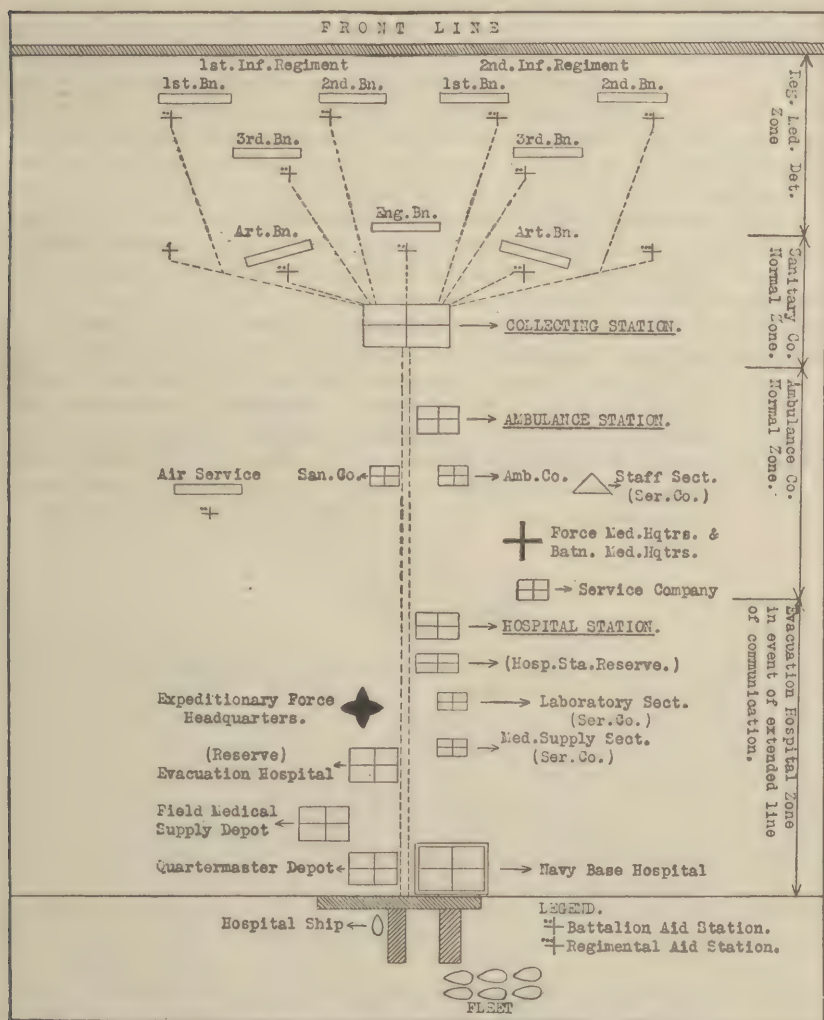


Fig. 195.—Internal organization of medical department with one infantry brigade, Marine Corps Expeditionary Force, showing distribution of different units.

ambulance station, thus forming a relay in the evacuation system from front to rear. For this purpose the hospital company is divided into two or more sections. In combat, a section establishes a hospital station where all sick, injured, or wounded cases are received and properly cared for. Surgical operations are performed when necessary, but the hospital company as a whole must at all times, to be fully effective, be capable of evacuating all wounded, so that the organization can advance as an active part of the

field force. This would be done, when the distance is not great, by evacuating to a hospital ship or a base hospital. When a unit of the hospital company which has established a hospital station fills up, another section establishes a new station and the first takes no more cases, but clears itself and then stands by to form a new hospital station. Thus during an advance the units of the hospital company would "leapfrog" each other.

This completes a brief outline of the mobile portion of the medical department of an expeditionary force. Under certain circumstances, however, if the distance between the hospital station and the base becomes too great, as in an advance, another medical unit must provide hospital treatment in order that the hospital company may remain mobile. This service is performed by the evacuation hospital, which is organized with headquarters and various subdivisions similar to those of a naval hospital. As its equipment is relatively elaborate, it moves only with the aid of a large number of trucks or by rail. It is intended to give the complete or definitive treatment ordinarily given by the hospital ship or base hospital, and is used only under the condition mentioned above.

The field medical supply depot carries sufficient medical and surgical stores to resupply the medical supply section of the medical battalion for a given period. This relatively frequent resupply is necessary in order that the supply section of the medical battalion may remain mobile. This depot also carries more elaborate dispensary equipment for regimental medical detachments and hospital equipment for the hospital company, which they may be able to use to advantage under certain conditions, as during the occupation of an enemy city, in a semipermanent camp, or in a defensive position from which no advance is intended.

Roentgenology.¹

In a single chapter dealing with roentgenology, it manifestly is impossible to attempt to explain all the details of technique and of diagnosis as applied to the study of X-rays. This chapter can act only as a sort of foundation for the beginner and show him some of the things that X-rays can or can not do.

Roentgenology is the study of roentgen rays and their application in the treatment and diagnosis of disease of the human body.

The discovery of X-rays was made more or less accidentally, by Prof. W. K. Roentgen, of Wurzburg, Bavaria, in the year 1895. While looking for invisible light rays, he turned an electric current through a glass vacuum tube. This tube was completely covered with black paper so as to prevent the passage of light. To his great surprise he noticed that a fluorescent screen, about 9 feet away, shone out brightly. There was no apparent source of illumination, except the tube, as there was no other light in the room. He also noticed that objects placed between the screen and the tube cast a shadow on the screen. By this observation he decided that the unknown ray must come from the tube. The ray came to be known as the unknown or "X-ray" and received its scientific name, the "Roentgen ray," from its discoverer.

X-ray physics.

Electric current, similar to matter of all kinds, solid, liquid, or gaseous, can be subdivided into units. Just as matter can be subdivided into molecules and theoretically into atoms, so can an electric current be subdivided theoretically into electrons.

¹ Prepared by Lieut. R. W. Hutchinson, Medical Corps, United States Navy.

Let us consider the primary unit of electricity to be a minute particle called an *electron*. The *ampere* is the unit quantity of current. Just as we can measure the quantity of water flowing along a pipe in one second, so the ampere is the unit of quantity of current flowing past one point in a wire in one second. *Voltage* is the unit measurement of current pressure and can be measured in units or volts just as the pressure of water can be measured flowing along a pipe.

When a stream of electrons is passed between the terminals of a glass tube, which is practically a complete vacuum, and its passage suddenly is interrupted, or, in other words, it hits something in its path, X-rays are produced.

The X-ray tubes in use to-day are of three kinds: (1) The gas tube, producing the finest type of X-rays but rapidly becoming obsolete, due to its difficulty of control; (2) the Coolidge tube, so named for its inventor, a very reliable tube which is in common use at the present time; (3) the radiator tube, a self-cooling tube which can be run for any length of time without overheating.

In order not to confuse the beginner, only one type of tube will be explained in any detail, namely, the Coolidge tube. The Coolidge tube consists of a glass sphere with two glass arms, one projecting on either side (Fig. 196), having electrical connections at their ends, called *terminals*. These terminals are known, respectively, as the *cathode* and the *anode* terminals. By reference to the illustration it will be seen that the ends of the terminals inside the tube are not connected, but that there is a definite gap between them. The cathode terminal projecting into the glass globe ends in a small coil of tungsten wire, which can be connected to a small storage battery so that it lights up and is heated in the same manner as the ordinary electric light is lighted and gives off heat. When a high-tension current passes through the X-ray tube this coil of wire gives off the electrons which pass across the gap between the terminals and produce the X-rays. The anode terminal consists of a solid rod of metal. The inner end is composed of tungsten, a metal chosen because of its high melting point and low vapor pressure density. The face of the inner end of the anode is inclined at an angle of 45° in order to direct the X-rays in the proper direction. This inner end of the anode terminal, known as the *target*, forms a sort of target against which the electrons strike when X-rays are formed. The formation of X-rays will be understood better by studying the details of figure 197.

Characteristics of X-rays.—X-rays are invisible, travel with the speed of light, and pass through matter according to its density. The more dense the substance the less readily the rays will penetrate it; lead, for instance, offers great resistance to the passage of X-rays, whereas aluminium allows the passage of these rays much more readily. X-rays, like other rays, differ in length; the shorter the ray the more penetrating it is; the more powerful the current used in producing the X-rays the shorter the rays within certain limits. The long rays are called soft rays and the shorter rays are called hard rays.

The X-ray machine.—There are many machines on the market at the present time and their characteristics vary greatly; however, all have certain char-

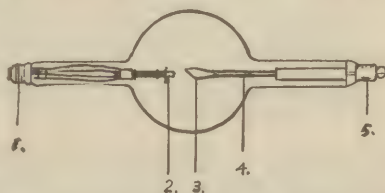


FIG. 196.—Coolidge tube: 1, Cathode terminal; 2, electron focusing cone; 3, solid tungsten target; 4, molybdenum supporting rod; 5, anode terminal. (U. S. Army X-ray Manual.)

acteristics in common. Practically all standard machines are manufactured to run on a 220-volt alternating current; an exception is in the case of machines used on board hospital ships and in naval hospitals, which are made to use a 110-volt direct current or a 200-volt direct or alternating current.

The transformer.—The important part of an X-ray machine is the transformer, which is to the X-ray machine what the engine is to the auto-

mobile. The 220-volt current is not of sufficiently high tension to produce X-rays. A very high electric tension is necessary to cause the stream of electrons to pass across the gap from the cathode to the anode terminal. A transformer is a device for changing a current from low pressure or tension to high pressure or tension, and consists of two coils of wire wound around a common iron core. (Fig. 198.) The coils are completely insulated from each other by being coated with oil or wax. One of these coils is connected to the main line, from which the power is obtained, and the other to the X-ray tube. When the current flows through the first coil of wire, another current, known as an *induced current*, the voltage of which is

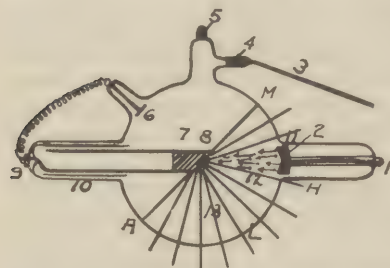
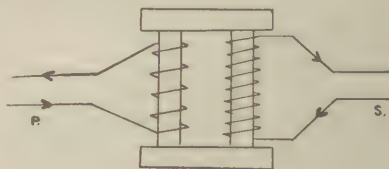


FIG. 197.—Gas tube: 1, Cathode terminal; 2, cathode of aluminium; 3, connections for softening; 4, softening material; 5, sealing off tip; 6, auxiliary anode; 7, copper block; 8, tungsten button; 9, anode terminal; 10, anode arm; 11, cathode arm; 12, electrons; 13, path of X-rays. (U. S. Army X-ray Manual.)

in proportion to the number of turns of wire in the second coil compared with the number of turns in the first coil, passes through the second coil to the X-ray tube. The current flowing in the first coil of wire is known as the *primary current* and the current flowing from the second coil of wire to the X-ray tube is known as the *secondary current*. The primary coil has a capacity of 220 volts, 60 amperes; the secondary a capacity of 100,000 volts, 70 milliamperes.

The motor.—The current induced in the secondary coil of the transformer is alternating, i. e., it changes its *phase* at a certain fixed rate, becoming negative, then positive, so many times a minute. A device is necessary to so change the path of the current that all negative elements will pass to the negative side of the tube and all the positive elements to the positive side. This device is included in every X-ray machine and is known as a *rectifier*. A common type of rectifier is in the form of a disk, revolved by a motor running at a fixed speed. The motor ordinarily used is a synchronous motor making 1,800 revolutions per minute.

The rotary converter.—When the current supplied to an X-ray machine is a direct current, a rotary converter is necessary in order that it may be changed to an alternating current; a transformer operating only when its primary is supplied with alternating current. The operation of a rotary converter is based upon the fact that the current flowing through the armature of a direct-current motor is alternating. This current is picked up by the brushes and



P PRIMARY.

S. SECONDARY.

FIG. 198.—Diagram of wiring of X-ray transformer.

furnishes the power for operation of the X-ray machine; the alternating current obtained being only about 70 per cent of the direct current.

Overhead wiring.—High-tension current, unlike low-tension current, requires very careful construction of the wiring and insulation in order that the operator and the patient may be protected. Low-tension current will pass into the body of a person actually touching an uninsulated wire of the primary. Contact is not even necessary in the case of the secondary, since, as we have already seen, the secondary possesses sufficient pressure to jump the gap between the terminals of an X-ray tube. The danger of current jumping the gap between the wire of the secondary and a person too near the wire is very great. The wires passing to the X-ray tube from the machine usually are strung overhead at a safe distance above the heads of anyone moving or standing about the room. Metal tubing one-half inch in diameter, attached to the ceiling with heavy insulators, now is being used to carry the current to the X-ray tube instead of flexible wire. From this metal tubing, flexible wires mounted on reels run down from above to the X-ray tube. They are out of the way of the patient and reduce the chance of accidental contact with patient or bystander.

The control apparatus.—It is necessary to have some method of control of the high-tension current, because in some forms of X-ray work it is desirable to use much less current than in others. This control is furnished, at the present time, by the *rheostat* and the *autotransformer*.

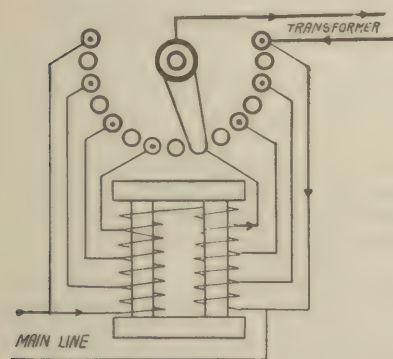


FIG. 200.—Diagram of wiring of an autotransformer. (U. S. Army X-ray Manual.)

as many coils of wire as is necessary to reduce it properly. The property of consuming current is known as resistance, and various kinds of metals have different resistances, or, in other words, consume more or less electric current. The unit of resistance is known as the *ohm*.

The auto-transformer.—(Fig. 200.) The auto-transformer is a somewhat more recent apparatus which allows more perfect control of both the amperage and the voltage of the current. It consists of a coil of wire wound around an iron core with taps at proper intervals to control buttons. It is a

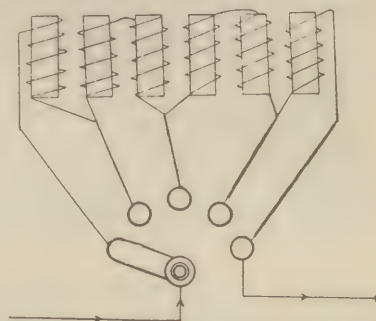


FIG. 199.—Diagram of wiring of a rheostat. (Christie, modified.)

The rheostat.—(Fig. 199.) When an electric current flows along a wire, a portion of the current is consumed, due to the resistance of the wire to the flow. The rheostat makes use of this principle in that it consists of a number of coils of wire through which the current is made to flow. The more coils of wire the current flows through the more it is used up and the smaller the amount which reaches the X-ray tube. Each coil is connected to a control button, and, by means of a dial on the front of the machine, the current can be turned into

transformer similar to the main transformer except that it consists of only one coil of wire. The auto-transformer works by the principle of self-inductance. The entire coil is the primary and the secondary is the portion of the same coil to the control buttons on a dial located in the front of the machine. If alternating current be applied to the entire coil, there will be voltage induced in any part of the coil bearing the same relation to the applied voltage that the number of turns of this part of the coil bears to the number of turns in the whole coil. The ratio between the number of turns in the primary and secondary currents is changed by setting the control lever on the various buttons on the dial.

The filament circuit.—(Fig. 201.) The filament circuit is the small coil of tungsten wire or filament, as it is called, which is located in the focusing cone at the inner end of the cathode (Fig. 196), and which is heated by a small storage battery. The two wires may be seen in the cathode arm passing to the terminal. Two wires pass from the cathode terminal to the storage battery.

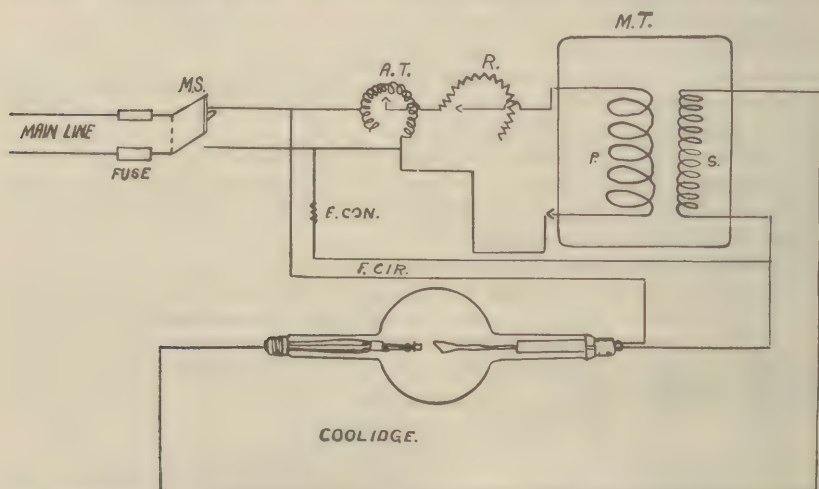


FIG. 201.—Diagram of the circuit of an X-ray machine: M. S., Main switch; A. T., auto-transformer; R., rheostat; M. T., main transformer; P., primary; S., secondary; F. Con., filament control; F. Cir., filament circuit. (U. S. Army X-ray Manual.)

One of the wires also carries the main current for the formation of the X-rays from the transformer, it being a principle of electricity that two different electrical currents may travel on the same wire at the same time independent of each other. The electric current from the storage battery heats the filament, the amount of heat being regulated by a small rheostat in the circuit. The amount of heat in this small filament controls the amount of electrons given off at the cathode. Hence we have a means of governing the amount and kind of X-rays given off by the tube.

The X-ray table.

Any wooden table of sufficient length and a convenient height may be made to serve as a table upon which to place the patient for taking X-ray films. Most of the tables now in use, however, are what are known as "tilt tables," that is, they can be turned from a horizontal to a vertical position to allow the patient to be examined in practically any position. Most tables are used both for fluoroscopy and for taking films. The tables have a lead box, con-

taining an X-ray tube, underneath, which can be moved the length and width of the table. The tables also may contain a device for taking stereoscopic plates.

Fluoroscopy.

Fluoroscopy is the study of opaque objects by means of X-rays and the fluoroscopic screen, and depends on the fact that under the influence of X-rays certain substances become highly fluorescent. The fluorescent screen consists of a layer of platino-barium cyanide spread on cardboard and protected by lead glass, mounted in a frame. When such a screen is held up in front of a patient with X-rays passing through him from the back, his body will cast shadows on the screen according to the density of the portion examined.

It is necessary for the person operating the fluoroscope to do so in total darkness in order that the shadows on the screen may be observed. The room should be darkened for at least five or ten minutes previous to the examination and the operator should remain in darkness for a similar length of time to accommodate his eyes.

As the fluoroscopy will be done in darkness, the control of the machine is obtained by a foot switch placed near the operator. Should there be necessity for light during the examination a ruby light, fastened overhead, is controlled by a foot switch. Red light does not destroy the accommodation, as does white light, and so may be used during the fluoroscopic examination. The room is darkened by double black curtains hung over the windows, thus allowing no light to enter the room.

The lead box containing the X-ray tube under the table is light proof and is lead lined. In front of the box is a diaphragm, movable in two directions, to permit the cutting down of the size of the image on the screen and so producing a sharper edge.

The X-ray current used in fluoroscopy is much smaller in quantity than that used for taking films. A 3-milliamperere current, 60,000 voltage, usually will be sufficient.

The operator should be protected against X-ray burns by a lead-impregnated apron and gloves. For details, see paragraphs on dangers and protection.

Roentgenography.

A Roentgen or X-ray acts upon sensitized plates in a manner similar to ordinary light and thus Roentgenography has much in common with photography. At the present time films, coated on both sides with a sensitized gelatin, have taken the place of glass plates, the reasons being that the films are less expensive, not so bulky, do not break, and are probably faster in their action than the glass plates. The sensitized coating covering the films consists of gelatin, containing a silver salt, generally the bromide. The gelatin is laid evenly on both sides of the film, and is identical with that used in photography except that the gelatin on the X-ray films is laid on much more thickly.

When light or X-rays come in contact with the sensitized gelatin, or emulsion as it is called, a chemical action takes place with reduction of the silver salts. In order to bring out the image, it is necessary to place the films in a developing solution. This must be done in a dark room illuminated only by a ruby light which does not act on the sensitive emulsion. Ordinary white light would ruin the film, even though it already has been exposed. The developing solution may be bought already prepared or its various chemicals may be obtained and the solution prepared from them. The main chemical

which makes the picture appear on the film does so by reducing the silver salt which has been exposed to X-rays to metallic silver. An alkali is added to hasten this action; the bromide is added so that the action will not progress too rapidly, and finally sodium sulphite, which preserves the solution by preventing oxidation of the reducer, is added.

A developer which has been recommended by the Army X-ray Manual and which has been found to be of value is here given:

Water (warm) -----	gallon--	1
Sodium sulphite (dry)-----	ounces--	8
Hydroquinone -----	do-----	1½
Sodium carbonate (dry)-----	do-----	8
Potassium bromide -----	dram---	1

Mix in order named.

After the film has been developed to the correct degree of dark and light (the exact degree can be learned only by practical experience), it is washed carefully but quickly in cold water and put in the fixing bath. A considerable amount of unreduced silver bromide remaining on the film must be removed by the fixing bath, which also contains chemicals for hardening the film. A popular fixing bath is given:

"A."

Pure water-----	ounces--	96
Hypo-----	pounds--	2
Sulphide of soda-----	ounces--	2

"B."

Pure water -----	ounces--	32
Chrome alum -----	do-----	2
Sulphuric acid (C. P.)-----	ounce---	¼

Mix "A" and "B" separately in the order named, then slowly pour "B" into "A," stirring continuously. Following complete fixation, the film is washed thoroughly in fresh water and dried.

The dark room.—The dark room should be made as nearly light proof as possible, all ordinary light being excluded. An ordinary ruby light carefully shaded will not act upon the sensitive film and will give enough light for work in the room. Supplies, especially unexposed films, should be kept at a distance from the tank containing the developer and fixing solution. Tanks for development of films have three compartments, entirely separated from one another. The central compartment contains running water; one of the other compartments (usually the one to the right) contains developing solution, and the remaining tank on the other side of the water compartment contains the fixing bath. These compartments are large enough to accommodate several 14 by 17 inch films at a time, and approximately 5 gallons of solution are used to fill each compartment. Tanks should be either lead lined or else constructed with a noncorrosive material. Enameled metal tanks are not very satisfactory. The dark room also is used in loading X-ray films into their cardboard holders. It is obvious that this can not be done in the presence of light.

Stereoscopic roentgenography.—X-ray films are necessarily flat pictures, that is, they show length and width but no depth. It is often very important to have the sense of depth in order to locate a shadow in the picture to determine

its proximity to the front or the back of part examined. For this purpose stereoscopic films are taken. Two films of the part to be X-rayed are exposed in exactly the same position, the patient being cautioned not to move during these two exposures. If a stereoscopic exposure of the lungs is made, the patient must hold his breath during the taking of both films. The X-ray tube is moved laterally a short distance for the second exposure. We then have two films of exactly the same part but taken from slightly different view points, the tube having been moved about 3 inches or the distance between the pupils of the eyes, before making the second exposure. The two films are placed, when dry, in a stereoscope consisting of two illuminating boxes mounted on a stand with two mirrors placed halfway between the illuminating boxes. The person examining the films looks into the mirrors and moves them backward and forward until the images come together. The image thus seen is as if from one film except that it has depth as well as length and width. Stereoscopy is especially important in the localization of foreign bodies and in obscure fractures.

X-ray accessories.

Intensifying screens.—The intensifying screen is one of the greatest aids in modern X-ray work. This screen does just what its name implies; it intensifies the action of the X-rays on the film, thus shortening the time of exposure. This is highly important especially when many films are taken of the same patient and the patient thus is exposed to radiation for a considerable length of time. When exposures of the thicker parts of the body are made, an intensifying screen greatly shortens the time. The intensifying screen consists of a thin layer of calcium tungstate upon a piece of cardboard. The newer form of screen is protected by a coating of varnish over this layer, thus eliminating the danger of ruining the sensitive layer by fingerprints or dirt. These screens are known as "washable screens."

As a rule the screens are fastened in a metal holder, called a *cassette*, two screens being placed in each holder. The sensitive sides of these screens are turned inward and the film placed between so that they are in actual contact with the emulsion of the film. The loading of the cassette, of course, must be done in the dark room to prevent the light from destroying the film. The cassette with the two screens enclosed is known as a "double screen," which ordinarily will reduce the time of exposure to about one-half to one-quarter of the time required without the screen. Double screens now are being used for exposures of the head, chest, kidneys, gastrointestinal tract, pelvis, and upper legs.

The Potter-Bucky diaphragm has contributed much to the perfection of X-ray films. Its action is based on the fact that when X-rays pass through the patient, the density of the body is such that some of the rays are absorbed, some pass through the body, and still others, on striking the dense tissues, are retarded and form so-called secondary rays which are given off at an angle from the path of the original rays. This scattering, as it is called, is responsible for much of the haziness seen in exposures of the thick portions of the body. The diaphragm consists of a grid, made of upright plates of lead, which moves across the film during exposure. The primary rays at right angles to the film pass through the openings between the grid, and all secondary rays coming off at an angle are stopped by the lead grids. The diaphragm, encased in a wooden case shaped to fit the body curve, is placed underneath the part to be taken with the X-ray tube, which is placed above the patient. The X-ray film, usually in a cassette, is placed in the holder underneath the wooden

case, and the motion of the diaphragm is obtained by means of a spring. The spring is released by a lever and a small bell indicates the proper time to commence exposure of the plate and to stop it. The diaphragm must be moving at a certain rate of speed or an image of the lead grids will appear on the film. Very excellent roentgenograms are obtained by the use of this apparatus.

X-Ray therapy.

X-rays now are used in the treatment of many diseases of the human body. These diseases may be divided into two classes, *the superficial*, which includes diseases of the skin; and *the deep*, which includes all of the diseases underlying the skin and those of the deeper structures. As has been mentioned previously, X-rays as they leave the tube are not all of the same length, but vary, some being soft (nonpenetrating rays), while others are hard (more penetrating rays). These different rays have different actions on the tissues; the softer rays having more action upon the skin and the superficial tissues, but not penetrating to the deeper structures; while the harder rays penetrate to the deeper structures. The softer rays have a greater tendency to cause an X-ray burn than do the harder rays. For this reason, when we desire to treat the deeper structures, the softer rays are filtered out so that the skin will not be burned during the treatment. Certain metals, if X-rays are passed through them, will absorb a portion of the rays, the softer rays being absorbed first. Of these metals the one most commonly used is aluminium; another, now coming into use, is copper.

In treatment of diseases of the skin, filters are not used, but in treatment of deeper structures an aluminium or copper filter is placed between the X-ray tube and the patient. Filters are made of varying thickness, from 1 to 10 millimeters in the case of aluminium. The longer we wish the treatment to be the thicker filter we use.

There are many diseases of the skin which X-ray therapy will benefit and some diseases it will completely cure, such as warts, acne, blackheads, certain types of skin cancer, nonmalignant tumors of the skin, certain types of chronic eczema, psoriasis, ringworm of the scalp and beard, and some infectious conditions of the skin. Not all of these are cured, but are certainly benefited. Psoriasis, for example, after a few treatments, will disappear completely, but practically always returns. Only comparatively short treatments are necessary for skin affections, because the rays do not have any tissue to pass through before they reach the diseased areas.

In the case of diseases of the deeper structures, X-rays at first were thought to be a cure for practically everything, but we now have learned to be more conservative in this regard. X-rays or radium are about the only agents that will reach many organs and structures which can not be operated upon. In the case of cancer, the X-rays, if given in sufficient doses, will kill the abnormal cells and stop the cancer growth; the deeper the growth, however, the more difficult it is to reach and the larger the amount of treatment required.

The unit of dosage is the "*erythema dose*," which is an amount of X-rays sufficient to produce a faint reddening of the skin. The usual procedure is to attempt to give just short of this amount; in some diseases, however, the production of this erythema is desired. If more than the erythema dose of X-rays is administered to a patient, unfiltered, in any region of the body, an X-ray burn will result. The severity of the burn depends on the amount of X-rays administered over the limit. X-ray burns are classified by degrees similar to other burns as: First degree or faint erythema, second degree with

partial destruction of the skin, and third degree with complete destruction of the skin and sometimes extending down into underlying fat and muscles. The distressing feature of the X-ray burn is that it does not respond readily to treatment, often lasting for weeks or months in spite of all treatment and producing permanent injury to the skin. The X-ray burn does not come on immediately after the exposure to the rays but usually appears from 10 days to a month thereafter. There is no means to prevent a burn after the exposure has been made. At the present time, with modern apparatus, there is no necessity for the occurrence of X-ray burns.

Dangers and precautions.

Electric current dangers.—Electrical current in the ordinary circuit for lighting and heating in a home is not dangerous to life. Actual contact with the wires carrying the current is necessary before an electrical shock will be obtained and then it is merely unpleasant and not dangerous to life. This is due to the fact that the current is a low-tension current. In the case of the X-ray apparatus, all the current flowing through the primary of the main transformer is low tension and the wire may be touched without fear of any serious accident. The current flowing through the secondary of the main transformer is of high tension, is very dangerous to handle, and contact with the wires is not necessary to get an electrical shock. When the machine is in operation this high-tension current is flowing through the wires running to the X-ray tube. This current varies in voltage, but the average is about 60,000 volts. Such a current will pass across a gap of 5 inches, which means that a person placing any part of his body within 5 inches of any part of this wire endangers himself to a serious electrical shock. The minimum distance usually is set at twice the spark gap distance, or, in the case of the 5-inch gap, 10 inches from the wire. The best rule for beginners is to stand several feet away from the machine and wires when the machine is in operation.

Dangers from X-rays.—The dangers to the skin of the operator and to the patient require careful consideration in order to prevent serious injuries. X-ray burns already have been mentioned in connection with therapy. Care must be taken not to expose the patient to a sufficient amount of X-rays to burn the skin unless this effect is desired in treatment. Idiosyncrasy on the part of the patient and carelessness on the part of the operator are the only causes for burning a patient. Some people seem to be extremely sensitive to X-rays; in fact, abnormally so, and may be burned by a dosage which would not affect an ordinary person. However, these cases are rare and more cases of burns are due to the operator's carelessness.

There is, however, a very real danger to the operator. The patient receives only the amount of X-rays necessary for the making of the films or for the treatment desired, whereas the operator unless protected, is being constantly exposed. The action of X-rays is cumulative; that is, exposure to rays does not have to be all at one time. A short exposure every few days, provided the sum total is sufficient, will cause just as severe a burn as will a large dose administered at one time. For the protection of the operator, the control stand of the X-ray machine usually is enclosed in a booth lined with lead sufficiently thick to entirely shut out the X-rays. When fluoroscoping a patient, the operator wears a rubber apron impregnated with lead. This protects his body very efficiently. His hands should be covered with rubber gloves impregnated with lead.

The pioneers in the use of X-rays had no idea of their action, and in consequence many of them received severe burns; some were very much mutilated,

losing fingers and even hands, while others made the supreme sacrifice. The modern operator does not encounter great risks as long as he keeps himself carefully protected. There always is a great temptation to palpate with the bare hand in the range of the rays and to neglect the wearing of the rather bulky apron and gloves.

REFERENCES.

U. S. Army X-Ray Manual.

The Principles and Practice of Roentgen Technique.—Hirsch.

A Manual of X-Ray Technique.—Christie.

Chemical Warfare.¹

The subject of chemical warfare is a matter of considerable importance to the Hospital Corps of the Navy for several reasons. While an authentic instance of the use of poison gas at sea is lacking, there are reports that indicate such a use by the Germans in the World War, and it is possible that it may be used in the naval battles of the future. Hospital corpsmen are subject to detail with the Marine Corps in operations ashore, in which case their problems are identical in most respects with those of the Hospital Corps of the Army. Furthermore, our hospitals no doubt will carry as patients men suffering from the after effects of war-gas poisoning who formerly were attached to and received their injuries during service in the Army or the Marine Corps.

Poison gas is by no means a new weapon. Perhaps the first organized effort to use poison gas as an offensive weapon was when the Spartans, in 431 B. C., attempted to suffocate the defenders of the besieged cities of Platea and Belium, thus rendering the attack less difficult. The Spartans burned great quantities of wood, pitch, and sulphur under the walls of these cities. They also melted pitch, sulphur, and charcoal together in great kettles and blew the fumes toward the defenders by means of bellows.

"Greek fire" was used by the Greeks under the leadership of Constantine against the Saracens about 673 A. D., and by the Saracens against the Christians during the Crusades. As far as can be ascertained, Greek fire contained not only readily inflammable material such as pitch, resin, and petroleum, but also sulphur and quicklime. If thrown upon water the reaction of water and quicklime produced heat sufficient to ignite the petroleum, which on its part developed enough heat to ignite the other combustible substances. The light hydrocarbons driven off from the petroleum, especially benzine, formed an explosive mixture with the air. As a result of explosions, enormous clouds of smoke and soot developed, and the sulphur volatilized in the combustion produced clouds of suffocating sulphur dioxide. It was very difficult to extinguish the flames because water poured on the fire only served to spread the flaming petroleum and thus increased the fire. Greek fire, as used by the Saracens against the Crusaders in the thirteenth century, may be classed as a forerunner of the flame thrower used by the Germans in the World War. Large syringes and pumps fashioned into the shape of dragons or other monsters with wide-open jaws were used to eject this or other burning liquids, especially petroleum, toward the enemy, who usually fled, terrified by the flames or stupefied by the gases.

During the Crimean War, Admiral Lord Dundonald, one of Great Britain's greatest sea leaders, submitted a plan for the reduction of Sebastopol by the use of poison gas. His plan was to vaporize large quantities of sulphur under the walls of the city and suffocate the garrison. The British Government,

¹ Prepared by Lieut. G. H. Mankin, Medical Corps, United States Navy.

while admitting that the plan was perfectly feasible and undoubtedly would secure the capitulation of the stronghold, would not permit its execution as it was considered that the effects would be so horrible that no honorable combatant would use the means to produce them.

The first use of poison gas in the recent war horrified the civilized world and produced a tremendous moral effect, not only upon the troops engaged, but throughout all countries. It was near Ypres on the 22nd. of April, 1915, that the first chlorine gas cloud attack was launched. The attack was on about a thousand-yard front and included the junction point of the French and British Armies. The British right was held by a regiment of Canadians and the French left by a regiment of Turcos, colonial troops. The attack was a complete surprise to the Allies. No protection whatever against this form of attack had been provided. Those who did not fall back or attempt some simple protective measures, as breathing through water-soaked cloth, became casualties. There is no way of determining accurately the number of casualties, but it has been estimated that about 7,000 were affected, of whom 350 died, a mortality of 5 per cent.

In the second attack delivered there was a smaller number of casualties, but a higher percentage of deaths. This may be ascribed to the fact that the concentration of chlorine gas was higher and the time of the attack longer, for the purpose of wearing down whatever protection had been provided. Wherever chemical protection was defective or exhausted, due to long exposure to gas, the resulting casualty was severe.

Between December 19, 1915, and August 8, 1916, five cloud or drift gas attacks were made against the British. The same method of releasing the gas was used as in the former attacks, except that higher concentrations were obtained and the time was somewhat shorter. In addition, the toxicity of the cloud was increased by mixing phosgene with the chlorine. Phosgene is a lung irritant having, predominantly, the faculty of producing its results late, and does not cause the spasmodic cough, when breathed, as does chlorine. It is approximately eight times more toxic, volume for volume, than chlorine. Large amounts may be breathed without producing the distressing symptoms that ordinarily serve as a warning.

During the World War cloud or drift gas attacks were produced by the simultaneous release of liquid chlorine or phosgene or mixtures of these materials from iron cylinders in the front line trenches. These liquids became gases or vapors when the pressure was released and were carried by the wind over the object to be gassed. The cylinders usually were placed in holes dug in the floor of the trench at intervals of 1 meter. The valves were covered with sandbags for protection against shell fire. In addition, there usually was a layer of earth or burlap impregnated with chemicals destined to neutralize any escaping poison gas. When an attack was to be launched the protective covering of sandbags was removed, the valve guard unscrewed, a lead pipe of sufficient length to reach over the parapet was attached to the cylinder and, with a favorable wind present, the valve was opened and the gas allowed to be carried along the ground by the wind toward the enemy. Almost without exception, all poison gases used in the recent war were heavier than air. This explains why gas was found in highest concentration after a gas attack in shell holes, dugouts, ravines, valleys, and trenches. Gas clouds frequently would flow around slight eminences so as to form islands which were free from gas.

After August, 1916, cloud gas attacks were used less frequently, not at all against the British, a few against the French, and quite a number against the

Russians. In one engagement two entire Siberian regiments, the Fifty-second and the Fifty-third, were wiped out. The partial abandonment of this form of gas attack may be ascribed to several facts. The gas cloud attacks were found to possess several disadvantages. Preparation for one entailed a large amount of work, considerable time, immense amounts of material, and if the enemy carried out a successful raid and discovered what was intended, the work of days was lost. The cloud attack is wasteful, it is dangerous to one's own troops, and is dependent upon the whims of the wind. A wind of too slow a velocity does not provide the necessary element of surprise, while a wind of too high a velocity does not allow the gas to remain over the object long enough to be effective.

To deliver a cloud gas attack it is important to know the state of the gas preparedness and the gas discipline of the opposing troops. Efficient and effective gas defense can not be gained in a day; it requires long periods of training. The British found themselves, at one time, opposed by a German naval division, which recently had occupied a sector of the line in Flanders. This division was provided with poor respirators, a poor system of gas alarms, and they were not trained in gas defense. It was decided to gas them as soon as possible. Accordingly the gas engineers occupied the trenches opposite the naval division. The Germans became suspicious and raided the trenches to get information. They found out what was planned, but could not hold the ground that they had gained. Immediately they began an intensive course of training in gas defense. Although they had a week in which to accomplish this before there was a favorable wind for the attack, it turned out that they were not sufficiently trained, and it is reported that there were about 1,500 casualties out of a total of 6,000 men exposed to the gas, and there was a very high percentage of deaths.

Cloud gas attacks were used only where there was reasonable expectation of good results; for example, against poorly trained troops or troops that had only recently arrived on the lines. The American Army received a few attacks of this nature when they first arrived on the firing lines.

Very approximately, the concentration of the gas cloud is inversely proportional to the square of the distance between the two lines. This provides a considerable element of danger to the troops releasing the gas. Nearly always there is some one affected while working around the valves on the cylinders.

Weather conditions are important in all gas warfare, but especially so in the case of cloud gas. If a wind is too strong, the gas is dispersed; if too weak it moves the cloud over toward the enemy so slowly that there is no element of surprise, besides a low velocity wind is notoriously changeable, and the results are often very disastrous to the attacking party. For example, the Germans attempted to gas a certain sector occupied by the British and the wind was of very low velocity. The gas rolled over the British trenches, the wind shifted and the gas rolled back over the German trenches and the Germans were seen moving many men out of the trenches the next day. Documents show that about 1,100 Germans were gassed through this shift in the wind.

Projector discharges caused results that were similar to those produced by cloud gas attacks. The British were impressed with the fact that the concentration in a gas cloud attack was greatest just in front of the trenches from which the gas is discharged. To obviate this defect, they used gas projectiles which were discharged from Stokes mortars. The amount of gas that could be sent over in this manner was truly remarkable. These mortars were able to deliver about 20 charges a minute.

Soon it became necessary to throw over larger amounts of gas in a very short time and the use of the Livens projector and canisters of gas fulfilled this need. A large number of these projectors were sunk into the ground at an angle of 45° . The range was varied by the size of the charge of black powder that was placed at the bottom. The canisters or drums contained phosgene usually and were exploded by contact fuse and booster charge. The discharge of these drums from the projectors was accomplished simultaneously by electricity, as is customary in blasting.

MEDICAL ASPECTS OF CHEMICAL WARFARE.

The important poisonous gases used in chemical warfare are few in number, but during a war new ones or new mixtures may be expected at any time. To better understand the actions of these gases they will be divided or classified according to their physiological action on man. It is impossible to draw hard and fast lines of distinction as the groups overlap somewhat in their effects.

1. *Lung irritants.* Examples: Chlorine, phosgene, chlorpicrine.
2. *Lachrymatory gases (tear gases).* Examples: Xylol bromide, benzyl bromide, brom-benzyl cyanide.
3. *Sternutatory gases (sneeze gases).* Examples: Di-phenyl-chlor arsine, di-phenyl-cyan arsine.
4. *Vesicant gases.* Examples: Mustard gas, Lewisite.
5. *Direct poisons of the nervous system.* Example: Hydrocyanic acid.
6. *Explosion gases.* Examples: Carbon monoxide, oxides of nitrogen.

Generally speaking, all of the gases in a given group will manifest similar actions and produce similar effects; therefore, with slight modifications, a single description for a particular group will suffice for all the members of that division. However, it must be clearly borne in mind that no absolute distinction can be made among the different groups, for phosgene, chlorine, and especially chlorpicrine, though primarily lung irritants, are also very effective lachrymators; and conversely, substances such as brom-benzyl cyanide, which, when present in small amounts, cause extreme lachrymation, act, in addition, as lung irritants at higher concentrations.

General symptoms produced by lung irritants.

With all of these gases, as a rule, nausea, retching, and vomiting are prominent features in the early stages of poisoning, especially in those who are severely affected by the gas. This may be due to the direct irritation of the back of the throat, and perhaps also of the stomach, owing to some of the gas being swallowed, or it may be the direct sequence of violent spasms of coughing.

If the case has been exposed to a high concentration of the gas, exudation of the fluid into the alveoli of the lungs soon commences, and as the quantity of the fluid increases asphyxial symptoms begin to appear since the fluid interferes with the respiratory exchange between the blood and the air in the lungs. Want of oxygen becomes, in fact, the dominating feature. Of the severe cases, some show extreme restlessness and anxiety, others a semicoma with a muttering delirium, from which as a rule they can be aroused to answer questions. Often consciousness is retained until quite near the end. Headache, pain behind the sternum and in the epigastrium are practically invariable, the breathing remains rapid (from 40 to even 80 per minute) and labored, but as a rule it is fairly shallow; it may be accompanied by occasional fits of coughing and retching, more often than not expectoration is scanty even though the lungs are full

of œdema, but occasionally there is an abundant discharge of the watery fluid often streaked with blood.

Even if there is no expectoration during life, foam almost invariably issues from the mouth and nostrils after death.

The cases in which pulmonary œdema develops to a serious extent tend to fall into two groups. The first group—blue type of asphyxia—comprises cases which show definite venous engorgement; the face is congested and deeply cyanosed, the lips and tongue are a full blue color, and there may be visible distention of the superficial veins of the face, neck, or chest. There is usually a considerable degree of true hyperpnea, i. e., the breathing is increased not only in frequency, but the actual amount of air reaching the lungs per minute is markedly above normal. Cough may be present, and expectoration of large quantities of thin frothy fluid is more likely to occur in this group than in the other. The pulse rate is usually little over 100 per minute and is full and of good tension. Second—the gray type of asphyxia. Cases in this group show an ashen pallor rather than deep cyanosis, the lips being pale and leaden colored, and they are in a general state of collapse. Respiration is rapid, but the increase in rate is partly compensated by the shallow character of the breathing so that the true hyperpnea is slight. Though the lungs are intensely œdematous, there is often little expectoration and cough is infrequent. The pulse is very rapid (130–140 per minute), weak, and running. The prognosis is much worse than in the first group.

Cases of the second group predominate in phosgene poisoning, but many intermediate types are seen. Sometimes a case which, at an earlier stage has shown congestive cyanosis with a full pulse, gradually will assume a gray pallor, while the pulse accelerates and weakens.

The delay in the appearance of severe symptoms.—Though acute pulmonary œdema may develop with great rapidity after exposure to a very strong dose of phosgene, it is of the utmost importance to recognize that in the case of less massive doses a very striking delay, even amounting to hours, frequently elapses between exposure to the gas and the onset of severe symptoms, and that during this interval the case may complain only of slight discomfort and may appear to be in good condition. This delayed action characterizes many of the lung irritant gases.

Treatment of poisoning by lung irritant gases.

Certain features of the treatment can be carried out only by a medical officer. However, there are certain general rules that every hospital corpsman should be familiar with in the care of gassed cases. For sake of completeness and in order that the hospital corpsman may be better able to cooperate with and assist the medical officer the details of treatment will be enumerated. In general, therapeutic measures are carried out in the following manner:

- (a) Rest.
- (b) Blood letting.
- (c) Inhalation of oxygen.
- (d) Warmth.
- (e) Diet.

It is of primary importance that oxygen need be reduced to a minimum by compulsory, absolute and prolonged rest. Under no conditions should evacuation be conducted otherwise than by stretcher or ambulances.

Blood letting.—Even at the first-line dressing station the patient who presents pulmonary œdema, signs of suffocation and of cyanosis, with frothing at the lips, should be bled as soon as possible. *Blood letting is as necessary for œdema as is the ligature for arterial hæmorrhage.* It requires no special apparatus.

It must be early and copious and from 300 to 500 grams of blood should be removed.

In cases presenting signs of advanced cyanosis it may be difficult to remove over 50 grams of blood. The administering of 0.25 gram of caffein may assist.

Oxygen inhalation.—With the signs of oxygen want, it is entirely natural to consider the administration of oxygen. The administration of oxygen should be carried out carefully at low pressure, and whenever possible the gas should be filtered through water. The administration of oxygen otherwise than by inhalation has been tried and found wanting. Rectal injection produces no effects, as the oxygen is not absorbed. Intravenous injections not only demand special apparatus, but, as they frequently result in plugging of the arteries, are dangerous.

Oxygen injections.—Subcutaneous and intramuscular injections have often been tried, without success, for the reason that a sufficient amount can not be introduced by this method.

Warmth.—It is of primary importance that the patient be kept at a comfortably warm temperature.

Diet.—During the first few days, dieting is indicated. Nourishment should be in the form of drinks, such as coffee or weak tea. Gastric disturbances may be combatted by administration of sodium bicarbonate.

Lachrymatory gases.

General symptoms and treatment.—Lachrymatory gases, such as xylol bromide and brombenzyl cyanide, are used for the purpose of putting men out of action by interfering with their vision, and not with the idea of producing serious casualties. Small traces of these substances cause profuse lachrymation, smarting of the eyes and spasm of the eyelids, making it impossible for the individual affected to keep his eyes open. These gases produce their intended results with much lower concentrations than is required in the case of the other types of gases. Some of these lachrymatory or tear gases are effective when present in a concentration of 1 part of gas in 25,000,000 parts of air. Stronger concentrations cause irritation of the respiratory passages, nausea, and vomiting. On leaving the poisonous atmosphere the symptoms subside in the matter of half an hour or more, depending upon the gas encountered, and no subsequent toxic effects are noted other than a slight redness of the eyelids and a moderate infection of the conjunctiva.

Irrigation of the conjunctival sac with sodium bicarbonate solution tends to allay the smarting sensation and to hasten the return to normal. The sodium bicarbonate solution is most efficacious in a 2½ per cent solution. The eyes should be protected from the light but should not be tightly bandaged.

Sternutatory gases (sneeze gases).

General symptoms and treatment.—Gases of this class, typified by diphenyl-chlor arsine, are very effective, in low concentrations, in producing congestion of the upper air passages and a marked flow of serum from the nose and at times distressing sneezing attacks. These attacks are not as common or as characteristic as the popular naming of the gas would indicate. Another effect which appears early and continues throughout the time that the individual is exposed to the gas is marked lachrymation. In higher concentrations there is to be noted burning and smarting sensations in the chest, with consequent cough and expectoration. In still higher concentrations, gases of this type may become true lung irritants in their effects and produce death in this manner.

Treatment is the same as for those suffering from the effects of lachrymatory gases, namely, wearing of the regulation mask while compelled to remain in the poisonous atmosphere and seeking of nonpoisonous atmosphere when possible; alleviation of the eye symptoms by irrigation of the eye with sodium bicarbonate solution. In case the higher concentrations have been breathed without the protection afforded by the regulation Navy standard mask and lung symptoms appear, the case then is treated as indicated under "lung irritants."

Vesicant gases (blistering gases).

Symptoms.—Mustard gas, or dichlorethyl sulphide, possesses two properties which differentiate it from other warfare gases and render it a particularly difficult weapon to protect oneself against. These properties are *persistence* and *insidiousness*.

A single inhalation of the ordinary lung-irritant war gases, such as chlorine, phosgene, and chlorpicrin, causes immediate irritation and institutes a defensive reflex at once. Not so with mustard gas. The action of this poison is not accompanied at first with any painful sensation. The only warning is a faint garlic odor, which is mixed with that of mustard. Nevertheless the gas is causing changes in the skin, eyes, and respiratory tract that later will be attended with severe symptoms. Those who are unfamiliar with this property of mustard gas frequently fall into the error of thinking that the absence of primary irritation indicates a concentration which is too low to be harmful.

The explosion of a mustard-gas shell, commonly designated "yellow cross shell" on account of its markings, sprinkles the surrounding area with a heavy liquid that tends to evaporate very slowly in cold weather and quite slowly even in warm weather. Consequently, contaminated objects remain impregnated and dangerous for a long period afterward. The heavy liquid soaks into any porous material and continues to give off toxic and blistering vapors. Hence, in the absence of an actual bombardment there is always the possibility that there will be casualties among troops that occupy the shelled area. This has been known to happen as long as two weeks after a bombardment. The gas is more persistent in cold weather than in warm weather, as might be expected.

When dealing with lung-irritant gases one is apt to gauge the effectiveness of the gas by its killing power. It is necessary to regard mustard gas in a different light. Its value lies in its casualty producing power.

On the average the first symptoms appear 6 to 12 hours after exposure, but with high concentration lesions have been observed less than 2 hours after contact. In other reports the time is given as averaging 24 to 36 hours.

The clinical picture of mustard-gas poisoning, in general outline, is about as follows: Several hours after exposure the man complains of nausea, headache, and a feeling of fatigue. There also is noted a smarting of the eyes, a watery discharge, and a swelling of the eyelids. Erythema of the skin appears about the same time as the eye symptoms, usually about the face, chest, buttocks, and between the thighs. As a result of the misinterpretation of this initial erythema nearly all of the first cases were regarded in the first hours as cases of scarlatina and isolated as such. Intensive blisters may develop, the usual site for these being the back, buttocks, scrotum, and wrists.

Inflammatory manifestations of the respiratory passages begin to appear about the second day after exposure, and are characterized by pharyngitis, laryngitis, tracheitis, and bronchitis. The earliest symptoms referable to the lesions in the air passages are hoarseness and cough. Often the cough is painful and incessant. The outstanding fact in connection with these lesions

is the formation of a false membrane lining the trachea and bronchi. This is the result of the direct action of the gas. The patient brings up thick purulent or bloody sputum, fragments of the false membrane, or even a cast of a portion of the trachea or bronchi.

The British, French, and American masks protected against any concentration of mustard gas attained in the field, therefore most of the cases admitted for treatment in the allied forces showed only skin lesions and conjunctivitis. Although these lesions were distressing in the symptoms they produced and kept a man on the sick list for several weeks, rarely, if ever, did they, in the absence of involvement of the respiratory organs, cause death. A fatal outcome usually is the result of the direct action of the gas on the respiratory passages or to a secondary infection in the lungs.

In the American Army there were 71,470 admissions as the result of poison gas; 27,119 were mustard-gas cases;² 34,046 were admitted as having been affected by "other gases"—that is, not classed under the heading of arsine, chlorine, phosgene, or yperite. It is believed that a large number of cases of mustard-gas poisoning may be found under the various headings mentioned above.

Mustard gas caused the loss of 1,286,784 days to the American Expeditionary Forces, as compared with 12,545,442 days lost as the result of all battle injuries. From this it would appear that mustard gas must be placed in the foremost rank as a producer of casualties. The Germans originally placed mustard gas in shells of 77 m. m., but later they employed shells of all calibers as gas carriers.

Treatment.—(1) Preventive measures: Since exposure to mustard gas is followed by an interval of several hours before symptoms appear, there is often an opportunity to carry out the measures designed to prevent or lessen the severity of the subsequent symptoms. It is of utmost importance that advantage be taken of this opportunity. The preventive measures consist of:

(a) Removal of all clothing and sponging the body with kerosene, a solvent for mustard gas, followed by thorough washing with soap and warm water. The skin then should be rinsed with sodium-bicarbonate solution. Scrubbing or friction should be avoided.

(b) Irrigation of the eyes with 2½ per cent sodium-bicarbonate solution or with 1 to 4,000 potassium-permanganate solution. Irrigations should be repeated at three-hour intervals.

(c) Irrigations of the nose, mouth, and pharynx, using sodium-bicarbonate solution.

(d) Administration of sodium bicarbonate by mouth to prevent digestive disturbances and to combat the general toxic action.

(e) Use of protective clothing and protective gloves by all those who may come in contact with mustard gas or mustard-gas cases.

(2) Curative measures: (a) Treatment of the conjunctivitis. Repeat the irrigations referred to above. It is at times necessary to instill a few drops of 2 per cent cocaine solution in the eyes every three or four hours if the patient experiences much discomfort.

If there is suppuration, instill a few drops of 1 per cent collargol solution or silvol solution in a strength of 5 to 20 per cent. This should be done every three or four hours. The eyes should not be occluded by a tight bandage; a compress hanging in front of the eye to protect it from the light is all that is required.

² Report of Surgeon General, U. S. Army, 1919.

(b) Treatment of the skin lesions. The erythemas, first-degree burns, require only protection from friction and pressure and the application of a dusting powder. The following is recommended:

Talc	2 parts.
Calcium carbonate.....	1 part.
Magnesium carbonate.....	1 part.
Zinc oxide.....	1 part.

Blisters should be opened aseptically by puncturing opposite ends and then coating the surface with an ambrine spray. In the absence of an ambrine spray, a watery paste, such as the following, gives good results: Talc, calcium carbonate, lime water, and glycerin, equal parts.

If the skin lesions become infected, the treatment consists of the usual surgical procedures.

The painful lesions of the genitals are relieved by hot wet dressings of normal salt solution left on for 20 minutes and following by drying, powder, and protection.

(c) Treatment of the respiratory tract lesions. The patient should be kept absolutely quiet. Spasms of coughing should be avoided by using codeine, heroin, or a sedative cough mixture under the direction of the medical officer, if there be one present. Hot applications to the chest and neck give relief.

(d) Treatment of gastro-intestinal disturbances. A liquid diet and the internal administration of sodium bicarbonate by mouth are the only measures of value. Other symptoms are cared for as they arise.

Direct poisons of the nervous system.

General symptoms and treatment.—The action of hydrocyanic acid, the only member of this group used in chemical warfare, is very rapid. After one breath of air containing sufficient concentration of that product, oppression and suffering at the temples and at the back of the neck are noted. Vertigo is present, the head is thrown back and prostration quickly follows. The body assumes an outstretched, stiffened attitude. Respiration ceases completely. This gas appears to act directly upon the respiratory center to paralyze it. Owing to the fact that this gas is lighter than air and was quickly dissipated by the air currents, it was used but little during the World War. The French used it in a combination of poisonous materials called "Vincenite." It was sent over to the enemy in shells, but never proved of much military value.

The swift and horrible nature of hydrocyanic acid poisoning generally forestalls intervention. First-aid treatment is a matter of minutes and consists in the removal of the patient to an atmosphere free from gas. If available, oxygen should be administered by inhalation. Stimulants, such as strychnine and caffeine, are indicated.

Explosion gases.

Carbon monoxide is not employed as a war gas, but is simply identical to the combustion of gunpowder. It is found, with the oxides of nitrogen, wherever firearms are in use. The German gas-casualty statistics seem to indicate that a larger number of casualties are traceable to the explosion gases, at least in the German Army, than was formerly thought. This substance is a colorless, odorless, and tasteless gas, lighter than air and diffuses rapidly in the open air. An explosion in a closed space such as a turret, compartment, or room, however, produces dangerous concentrations quite frequently, depending on the relative size of the compartment and the projectile.

Symptoms: Probably the first symptom noted in a case of moderate severity is dizziness, languor, headache, weakness, and loss of appetite. Where the intoxication is more severe there is dizziness, also severe headache, vomiting, convulsions, dilated pupils, and the face is, as a rule, livid.

Treatment: Oxygen inhalation, with a view to displacing the carbon monoxide in its combination with the hæmoglobin of the blood, is indicated where available. This, of course, should be carried out after the patient has been removed from the contaminated atmosphere. If there is an absence of voluntary respiration, artificial respiration by the Schafer method should be resorted to. Friction is applied to the region of the heart. The diet should be restricted to liquids, but no liquids should be given by mouth until it is absolutely established that the patient is conscious.

The oxides of nitrogen rarely ever occur in such amounts in explosion gases as to cause symptoms calling for treatment beyond that administered for poisoning by the more deadly gas, carbon monoxide.

REFERENCES.

Pathology of War Gas Poisoning.—C. M. Winternitz.

Archives of Internal Medicine, XXIV, 683.—R. S. Berghoff.

Journal of the Royal Army Medical Corps, XXXV, 80, 83, July, 1920.—C. G. Douglas.

Report of the Surgeon General of the U. S. Army, 1919.

Chemical Warfare.—A. A. Fries and C. J. West.

Deaths and Medicolegal Matters.¹

Silence.

The first rule of conduct for the hospital corpsman is to maintain a close guard upon his words and his actions. If he thinks twice before he speaks and then speaks not at all, he often will have cause to congratulate himself upon his good judgment.

Sad experience teaches this lesson in due course of time, or else the individual will find himself no longer connected with medical activities. The young man just entering upon a career in the Hospital Corps should try to acquire the habit as soon as possible. Moreover, the old saying that actions speak louder than words must not be forgotten. Information can be imparted intentionally or unintentionally by an appearance of excitement or a shrug of the shoulders as clearly as by voice.

This does not mean that matters are not to be discussed with persons who should know of them, but it does mean that idle gossip is to be avoided. The senior hospital corpsman and the medical officer are entitled to a knowledge of everything pertaining to the medical department that comes to the attention of the junior hospital corpsman. Take your problems to them. Whether the information should go further is a matter to be left to the judgment of the medical officer. The hospital corpsman acting alone is responsible to the person in charge.

The very foundation of a successful medical department is based upon confidence. We often have glimpses into the innermost thoughts and habits of our patients that are denied to others, and it is only under such conditions that we can properly minister unto them. We want a man to know that he can come to us, feeling that what he says or does will reach only those who are

¹ Prepared by Lieut. Commander C. W. O. Bunker, Medical Corps, United States Navy.

to help him. The minute that he thinks that any of us have abused his confidence we have lost our opportunity to aid him and have placed the medical department under a cloud.

But you also must be close-mouthed about other things than patients. Extend the habit to cover all the activities of the medical department. This is not for the reason that they are so secret, but because the person to whom you talk probably will not understand fully. He has not been trained medically and is not qualified to pass judgment. You have merely provided something upon which the imagination can work, and there is no telling where the incident will end. This applies not only to sanitary measures or ordinary occurrences, but particularly to accidents occurring in the sick-bay or operating room, to deaths from other than natural causes, etc. The medical officer bears the responsibility and it is for him to handle the situation.

The prohibition against talkativeness is to be emphasized especially in connection with this chapter. The hospital corpsman, by reason of his duties, comes intimately in contact with situations that afford rich material for gossip. Operations, deaths, autopsies—all, in time, may become largely matters of routine to him. To others, however, they are unusual, and their details serve to gratify a merely morbid curiosity. The talkative hospital corpsman is always certain of a large and attentive audience, but not necessarily one of the highest order of intelligence. His story soon becomes entirely distorted as it is passed along. But the matter does not end there. He has betrayed a confidence and loses in large measure the respect of his fellows. Certainly they will not entrust him with their own troubles. The distortion of his tale may bring his department into disrepute. His value as a witness is lessened, for he may have said something in his enthusiasm as a story-teller that he would not feel justified in repeating under oath. He may have handicapped the investigation of some criminal act and thereby caused much inconvenience to the course of justice. And, last but not least, he may have made public something that, for the good of the service, should have been kept quiet.

So, by your words and your bearing, always strive to create confidence in the efficiency of your medical department. Make others feel that there they will find competent treatment for their ills and solution of their sanitary problems; that you are incommunicative, not because you are unsociable, but for the reason that *you mind your own business*. No matter whether things are going right or wrong, be calm, close-lipped, cheerful, and efficient. In other words, live up to the best traditions of the Hospital Corps.

Property.

The duties of the hospital corpsman often make him responsible for the property of others, and he will save himself and others much trouble by being very careful. Few things cause as much worry and ill-feeling as an accusation by a patient or next of kin that some possession has been lost or stolen.

The Manual of the Medical Department, United States Navy, 1922 (paragraphs 1872 and 3420), prescribes the routine to be followed relative to the effects of a patient being transferred. The original inventory on the hospital ticket (Form G) is very important, as it is the very basis of the transaction, and also because the patient may not see all of his property again for days or months, or, perhaps, never. And, when he does take charge of them again, there must be no question as to whether the list is correct. So prepare it carefully, and with your own eyes see every item that you enter. Do not simply ask the patient what he has and put down what he says.

The patient usually is able to assist with the inventory, but occasionally he can not do so because he is too ill or is insane. You then must double your precautions and should have a witness to the inventory.

In the ward the patient often keeps certain valuables with him, such as a watch, jewelry, small change, etc. He should be advised to place them in safe-keeping, but usually does not do so. You will develop an excellent habit if you have a good idea of what is in his possession. He may claim that something is missing, or he may become unconscious, or he may die. You are then in a position to speak authoritatively as to whether everything is on hand that should be. (See par. 1795, Manual of the Medical Department, U. S. Navy, 1922.)

Often there is occasion to take charge of personal property, including valuables. This occurs upon death, or when a corpse is found, or when a patient for some reason can no longer guard his property. Ordinarily it should be done immediately, for valuables have a curious habit of soon disappearing. Do not wait an hour or so, but see that the property is placed as soon as possible under the care of the proper person. (See section 6 of chapter 19, Manual for the Medical Department, U. S. Navy, 1922.)

Dispensing.

Matters of life and death are always under your hand. This will be novel at first, but soon becomes familiar and tends to be mere routine. The hospital corpsman must closely guard himself against the development of such an attitude. He is surrounded by death-dealing agents and uses them constantly. The mistake that results in death or serious illness is not merely a sad occurrence. It makes you criminally responsible.

Every endeavor is made to supply all reasonable means of avoiding mistakes in the dispensing of drugs and the use of poisons. The regulations specify that the dangerous ones shall be placed in special bottles or kept under lock and key so that there may be no mistake. The poison bottles can be recognized easily in the light or in the dark. Failure to detect the poison bottle can be due only to gross carelessness.

Hold your drugs and chemicals in deep respect, and cultivate at the outset the habits of care and precision. Be sure you are wide-awake when you use one. Inspect the container, read the label, and be certain that it is the one specified by the prescription or by your instructions. Settle any doubt by inquiry of the proper person. Label the containers promptly, and never think that you can guess the nature of the contents when there is no label. *Never do any guessing.*

One of the greatest sources of trouble is the care of alcohol and narcotics. It is in their care and use that you are particularly liable to the law. The Manual of the Medical Department, U. S. Navy, 1922, in paragraphs 737, 738, 739, 755, 756, 1157, 1699, 1723, 1794, 2064, discusses this subject, and the hospital corpsman must be thoroughly familiar with it. The very number of references indicates its importance.

The insane.

Another situation, in which the hospital corpsman shoulders great responsibility and is very liable to come in contact with the law, is in the care of the insane. The very nature of his calling, naturally, will insure the best of care for the patient. But the problem goes deeper. It must be realized that an insane person is not responsible for his acts. He is a sick man, and does not think in all things in the same manner as you and I. Our duty is to protect others who may come in contact with him, and also to guard him against himself.

Usually you have some person who has the responsibility for the welfare of the patient, and your instructions will be definite and complete. But it is your duty to use your common sense to the utmost. The person who is mentally unbalanced is extremely likely to injure himself seriously. Keep him under constant observation. Remove articles that are dangerous. *Do not take any chances.*

It may fall to you to guard him while traveling, or while he takes exercise on the deck of a ship, or in the grounds of an institution. Then you must be trebly careful. He may attack others, or try to escape, or attempt to commit suicide. It will happen unexpectedly and most suddenly, and he may avail himself successfully of some opportunity that you failed to consider or did not think of importance. Remember that his condition may lead him to think or reason in a different manner than you would.

Your best procedure is to cultivate the friendship and respect of the patient. How to do so is a problem in each case, but usually it can be done, and your success in handling him will depend upon your ability to do so. And never forget that he is a sick man. He may make a nuisance of himself or attack you, but he is not really responsible. Your duty is to control him, but it must be done by as gentle means as possible. *Never lose your temper.*

Dying declarations.

You may happen some time to be the one to whom a person at death's door makes a statement of importance; that is, a dying declaration. It may have to do with matters of money, property, or some criminal incident. Under any circumstances it is an expression of the thoughts and desires of a dying person. In it may lie the clue to the solution of some problem of crime. Therefore you should exercise every care to understand it correctly and fully.

To have full weight in law, however, and to be admissible as evidence before a court, the dying declaration must be made and recorded under certain definite conditions. You assume, then, real responsibilities when circumstances compel you to receive such statements. And it is your duty to know how to insure that they be of legal value, and to make them so.

The person making the statement must be convinced that his death is soon to occur—he must have no expectation or hope of recovery. Assure yourself that this is his attitude, and also, to the best of your ability, as to whether his mind is clear and rational. Then explain to him the importance of the statement he is about to make.

The statement must be voluntary; that is, not forced. Write it in his own words as he makes it, and be very careful not to include anything that he does not say. Do not put down what you think he should have said. If it can be done, have the person swear to his words before proper authority.

A declaration made thus will be of value in the eyes of the law, but you should not hesitate to take any such declaration under any circumstances. Take it in writing, and remember which of the above conditions has or has not been fulfilled.

Signs of death.

We all are familiar with the tales of persons being buried alive. Such occurrences are rare, and the responsibility probably would never fall upon a hospital corpsman. The occasion may arise, however, when timely measures would save life that wrongly was supposed to be extinct. The proper equipment of the hospital corpsman should, then, include a working knowledge of how to recognize death. He then will be in a position to apply first-aid treat-

ment and possibly save a life that would have been lost had he erroneously considered the person to be dead, and done nothing until the arrival of others.

The decision as to whether the person is dead ordinarily is made by a medical officer. It is only when you are acting alone that you will be obliged to make it.

Death is considered to be present when the heart no longer beats and when respiration has ceased for more than 20 minutes. Both conditions must be present, and their proof is not always as simple as you may think. Do not rely upon any single test, but consider the results of all. No one test is conclusive.

Test for the heart's action by feeling the pulse, and by feeling and listening over the heart. A stethoscope should be used for listening. If no pulse or heart beat is heard or felt, further evidence may be afforded by holding the hand, with the fingers extended and close together, against a bright light, and comparing the result with your own hand. After death the redness that you can see in your hand is *usually* absent, the hand in question looking dull or opaque. Tie a cord or wrap a rubber band tightly about a finger near where it joins the hand. If the blood is circulating the finger will become swollen and bluish *within a few minutes*; no change is found when death is present. But remember that, if the cord is too tight, the blood going into the finger through the arteries may be stopped as well as that flowing out through the veins. Swelling and bluish color is secured when the pressure is just enough to stop the return venous flow but not sufficient to prevent the arterial.

Test the respiration by watching the chest for movement and by listening over the windpipe (trachea) in the neck, preferably using a stethoscope. Examine for at least 20 minutes. Have a good illumination, and you will find that a cross light (one that throws some shadows) is best. A further test is made by holding a very cold mirror before the mouth and nose. Moisture will collect if there is breathing.

The preceding examination is usually sufficient, and covers the early signs of death. The more important of the later signs are—

1. Changes in the cornea of the eye.
2. Cooling of the body.
3. Pallor of the body.
4. Rigor mortis.
5. Cadaveric lividity (sugillation).
6. Putrefaction, saponification, or mummification.

The *corneal changes* consist of loss of sensation, loss of transparency, and wrinkling. To be of real use, one must know the condition of the cornea before death.

The *temperature of the body* must be judged by the use of a thermometer placed in the rectum. Do not rely upon your hand. Occasionally, the temperature rises for a time after death, but cooling soon begins, and its rate and extent will depend upon many things. It usually will be about 4° F. per hour for the first three hours, 3° per hour for the next six hours, and then rather more than 1° per hour.

A corpse usually has a peculiar *ashy color* that is suggestive but not conclusive as regards death.

Rigor mortis is a stiffening of the muscles and results in rigidity of the body. It usually appears within 2 to 8 hours after death and lasts from 16 to 24 hours, but both onset and duration are subject to wide variations. It extends commonly from the eyes gradually down over the body, and disappears in the

same order. The muscular spasm and rigidity that occurs in some cases of poisoning may resemble it.

By *cadaveric lividity* is meant the purplish or reddish-violet colored spots that appear in about 12 hours after death, and are due to the settling of the blood into the parts of the body that are lowest as it lies. These spots often are mistaken for bruises. Upon cutting, however, bruises will show considerable blood or even a clot, while the spots under consideration will not do so. They are positive proof of death.

Putrefaction, saponification, and mummification are, of course, absolute proof of death. Putrefaction (rotting) does not appear until rigor mortis has gone, and its onset usually occurs within a few hours to many days, depending upon the circumstances. Saponification and mummification are late incidents, and unusual. They preserve the body for long periods of time. Saponification means the conversion of the corpse into a fatty or waxy substance called adipocere. Mummification consists in the complete drying of the body.

Care of the dead.

The hospital corpsman should familiarize himself with the general procedure in cases of death, studying particularly chapter 19 (p. 318 and succeeding pages) of the Manual of the Medical Department, United States Navy, 1922.

Frequently you will be obliged to take charge of the body of a person who has just died. Your first duty in such a case is to consider the living. Remove all traces of death as soon as possible. A death is very depressing to other patients, and one should try to avoid having it occur in their presence, as in a ward. The medical officer usually will order a patient on the eve of death transferred to a private room, if possible. When this can not be done, the bed should be well screened.

The imaginative or morbid patient who realizes that a death has occurred in his vicinity will imagine himself as possibly dying and his body being treated as he sees you treat this one. So bear yourself well in hand, and be quiet, calm, orderly, and, above all, respectful. Make others do the same. There is no place at such a scene for noise or tomfoolery. Let us respect our dead. And this should apply not only for the moment but at all times until and after the remains have been removed from the institution.

When the patient has been pronounced dead, take charge of the remains and, possibly, the personal property, if no person in authority is available immediately. Gather the property together, store it safely for the moment, and make a list of it and transfer it as soon as possible to the proper person. (See par. 1795, Manual of the Medical Department, U. S. Navy, 1922.)

Certain things (given below in detail) must be done for the corpse, but, unless it lies in a private room, these are accomplished best in the morgue. Before the body is removed from the bed, fasten securely upon it a tag that bears the full name and rating of the person, the ward where death occurred, and the date and exact time of same. Removable teeth must be sent with the body. If death has been due to a contagious or infectious disease, the body must be wrapped in a sheet wet with 5 per cent phenol (the official embalming fluid is preferable, if it is available) before being transferred. When the body has been removed, disposition is to be made of the bedding, and the bed, bed-springs, bedside table, etc., need attention. This varies with the customs of the institution and with your instructions, but the use of soap and hot water and a disinfectant is essential. It is a good general routine, however, to remove all bedding, including the mattress, if the death occurred in a

ward. No patient likes to believe that he may be obliged to use such a mattress. Disinfect the bedding, to still the wagging tongues if for no more important reason, and wipe the furniture with some suitable disinfectant.

The body must be "laid out" as soon as possible. Rigor mortis may begin quickly, and its presence renders proper care difficult. But early attention is desirable for other reasons, as well—prevention of discharges and soiling from the anus, the penis, the vagina, the mouth, and the nose, or other openings. Pack these openings tightly with cotton. A little salt in the cotton may be of help. Discharge from the penis is best prevented by tying a length of bandage tightly about it. The packing for the mouth should go well back into the throat. Insert any artificial teeth. Place the body on its back, and straighten the limbs, holding the knees together with a loose, broad bandage. Place the hands across the chest or abdomen, and secure the wrists together loosely with a broad bandage. The head should be slightly elevated by means of a pad or block. The mouth must be closed. It is better to hold the jaw in position by means of a support, such as a folded towel, beneath the chin, rather than use a bandage. The eyes must be closed. If they do not remain so, place wet pledgets of cotton upon the lids, or, if necessary, insert a very small piece of dampened cotton beneath the upper lid. Finally, cover the body with a clean sheet, or, if necessary, rewrap it in the sheet that has been wet with phenol.

Deaths from unnatural causes.

The first rule of conduct, when one finds the remains of a person who apparently has met his death from violence or other unnatural causes, is to avoid any disturbance of the body or of objects in the vicinity. Assure yourself that the person really is dead, and then see to it that nothing is disturbed until those in authority so direct. This applies to others as well as to the hospital corpsman, but, as he probably will be in charge, his will be the responsibility.

Avoid unnecessary handling of objects about the corpse, especially such as may bear fingerprints.

Your only reasonable excuse for disturbing anything will be to ascertain whether or not the person is dead. And, before doing so, you must form a clear mental picture of the condition and position of the body before disturbance. Meanwhile, you will have notified the medical officer or other person in authority. If no messenger is available and you must leave the remains, endeavor to prevent possible tampering by others, as by locking the room. Return and reassume charge as soon as possible.

You probably will arrive at the scene early, and you must try to make yourself a useful witness. Imprint clearly upon your memory the position and condition of the body and of objects in its vicinity. This requires that you use your common sense to the utmost. Prepare a private record of the results of your inspection at the earliest possible moment. Memory is treacherous, and later you may be very thankful for such notes.

Previous remarks relative to valuables apply here also. Inventory those that are visible, and then you will be in a position to help if the question arises later as to whether something has been lost or stolen.

Your habits of silence will be of particular importance in connection with unnatural deaths. Beyond its value in general, as already discussed, here you must anticipate a probable call to the witness stand. Your knowledge is clear in your memory, as well as clearly stated in your notes. If you discuss the matter with unauthorized persons, you will hear all sorts of suggestions and comments, and, before long, your own knowledge may become so contaminated that you doubt whether you really saw what you thought you did.

And unconsciously you even may permit the opinions of others to replace your own. The court is not interested in this hearsay evidence—the thoughts of other persons. It desires what you know of your own knowledge, and you must strive to preserve that intact and clear-cut.

Identification of the dead.

This problem usually will fall to the lot of persons other than the hospital corpsman. Still, he may find himself so situated that he must give an opinion, and he should be familiar with the means that may be employed.

The records kept in the naval service are usually very complete as to the physical characteristics of each individual. There are the health record, the service record, and the fingerprints. The portion of the health record that is devoted to the teeth is of great importance.

There is also the identification tag. But even the findings of such a tag with the body must not be considered conclusive evidence of identity. The characteristics listed in the above-mentioned records of the individual specified by the tag must check with those of the corpse before identification can be considered as established. A finger print also must be made, and compared with that on the tag.

The procedure to be followed, then, involves a careful examination of the body for the points recorded concerning some missing person. Not only marks, moles, and scars must be considered, but also external measurements, color of hair and of eyes, deformities, etc. It is especially important to compare the teeth closely with the description in the dental abstract.

It is surprising how obscure scars, moles, freckles, and birthmarks can become after death, even when decomposition has not occurred. The latter, of course, adds to the difficulty. So, the search must be very carefully made, and it is all-important to have a good light. It is for this reason that the dental record is of such able assistance. The peculiarities of the teeth are very reliable and permanent.

It is the finger prints, however, which will settle any doubt. The epidermis is very resistant to decomposition. As long as it is present, it will be rare that serviceable prints can not be secured if proper care is exercised. Even when the skin is shriveled, good results usually can be obtained by carefully following the directions given in paragraphs 1489, 1491, and 2924, Manual of the Medical Department, U. S. Navy, 1922 and in subsequent circular letters from the Bureau of Medicine and Surgery.

Occasionally, the remains consist only of a number of bones. The teeth will help in such a case. Otherwise, the identification will be beyond the ability of the hospital corpsman. If other aid can not be secured, his problem will be to determine how many bodies are represented by the bones. This is not so difficult if many bones are present. Look for duplicate bones, but remember that there are two sides to the body.

Post-mortem examinations.

After death, a body often is opened for examination, the proceeding being known as a post-mortem examination (also called necropsy, necroscopy, or autopsy).

The duties of the hospital corpsman at such an examination are those of an assistant. It lies, however, within his power to make the task run smoothly, or to have it unsatisfactory. We exercise great care of our instruments in the operating room, but the same can not be said of those in the morgue. Your first duty is to have them in proper condition—cutting edges sharp, forceps that grasp, joints that are snug, etc.

A commendable attitude on your part is to strive to fit yourself to perform the autopsy with your own hands. This, of course, means close observation of others at work, and intensive application. Study your anatomy, and also the sections to be found upon autopsies in textbooks. In time, you may attain the necessary proficiency, and you will have benefited yourself in knowledge and also in efficiency as a hospital corpsman. Moreover, the instruments in your care will receive proper attention because you have had to use them.

It will be your duty to prepare the room, instruments, utensils, etc., and to care for them when the examination is finished. It probably will be your duty also to close the openings (incisions) that have been made in the corpse, and you may be directed to embalm and dress the body, under supervision. Just as in the operating room, no two medical officers will pursue precisely the same method, and you should ask beforehand for instructions as to doubtful details.

As regards the room where the examination is made, have it neat, clean, and comfortable. Be sure that the lights are in good working order. A portable light will be found useful at times, as well as a flashlight. Regulate the heat, and also the ventilation. There is a great tendency to neglect these last-mentioned details, and the result is that often some of those present "catch cold." So, provide for the escape of odors, but do not do so at the expense of a proper warmth and freedom from drafts.

Have the water supply working properly. If there is piping for hot water, see to it that hot water is available. The plumbing needs care, and you should remember that the traps may retain fluids which will decompose and cause foul odors. It is well to flush them with some hypochlorite of lime (*Calx chlorinata*) mixed in water after each use of the room.

Check your scales occasionally to be certain that they weigh accurately.

You should also exercise due economy in your work. Good hand towels, absorbent gauze, and absorbent cotton are expensive. They may be needed for certain purposes, but certainly never for cleaning or mopping about the room or about the corpse. Old, surveyed linen is available for such purposes. Sections of crash toweling also can be used to advantage for less filthy tasks.

Certain equipment, in addition to the furniture of the room, must be provided, and, if possible, it is preferable to have a locker for storage of the same rather than to attempt to secure it in a hurry just prior to the examination. At that time, you may not have much notice. The medical officer will indicate his special desires as regards equipment, and will advise you if any unusual procedures are contemplated. The list below includes articles that should be available as a matter of routine for the examination itself. Cleaning gear for general use will be in addition.

Three rubber aprons.

Four gowns.

Rubber gloves for three persons. (Provide an extra pair for each person, and have them of the size and weight desired by those who will use them.)

Six hand towels. (For use at the sink by persons who may desire to cleanse their skin.)

Soap. (For the hands.)

Two sheets. (For covering the corpse.)

Cotton, absorbent. (To be used sparingly.)

Gauze, absorbent. (To be used sparingly.)

Bandages, gauze. (Assorted sizes.)

Neuroscopic case of the Supply Table of the Medical Department, U. S. Navy, 1922. (Be certain that each article is in good working order.)

Head block. (Used beneath the neck of the corpse to hold the head forward while removing the brain.)

Three sponges, about the size of a man's head. (These are very useful for mopping about the corpse. Great care, however, is necessary in order to keep them in sanitary condition. Cleanse them thoroughly with water after use, and store them in a large jar of 2 per cent formalin.)

Twine. (A ball of same for use in tying during the post-mortem examination.)

Board, 1 inch thick by 18 inches square, and smooth. (For use in sectioning organs.)

Needles and thread. (For use in closing cuts in the corpse. These are selected according to the desires of the person doing the work.)

Trays, enameled. Two sets of three each, nested, as in the Supply Table of the Medical Department, U. S. Navy, 1922. (For holding and local transportation of organs, etc.)

Three buckets, agate, as in the Supply Table of the Medical Department, U. S. Navy, 1922. (One for use at the drain of the table, one for rinsing sponges, and one for general utility.)

Memorandum pad and pencil. (For taking notes during the examination.)

Outfit for tissues or fluids that are to be saved for histological or bacteriological examination. (See below.)

Outfit for material saved for chemical examination. (See below.)

Outfit for disinfection of cuts, punctures, or abrasions occurring during the examination. (See below.)

The corpse having been placed upon the table prior to the necropsy and covered with a sheet, clear the vicinity of idly curious spectators, and then make your preparations. Your equipment is at hand, and you have regulated details of heat, ventilation, water, etc.

Arrange the contents of the necroscopic case and the sponges upon a cloth-covered table where they will be convenient to the hand of the pathologist (the person who is performing the necropsy). The linen, trays, and other materials are placed upon another table where you can reach them. Place a bucket where it will catch the drainage from the table. When the time for the examination arrives, remove the sheet from the corpse, put on your rubber apron, gown, and gloves, and be prepared to assist as you may be directed.

The skin of those working at a necropsy may be broken accidentally by needles, instruments, and otherwise. Such wounds may become infected and be very serious. The medical officer will prescribe the proper treatment, but you should have at hand some things for immediate disinfection, including a 200 c. c. bottle of tincture of iodine, wooden applicators, absorbent cotton, small pads of sterile gauze in muslin packages, and gauze bandages.

When the necropsy is finished, the openings that have been made must be closed and the corpse cleansed and dried. The closing is to be done neatly by means of needle and thread and a simple running stitch. Your aim is to leave the body presentable, not only as a matter of pride, but also because it probably will be viewed later by friends or relatives. It would be a waste of time to try to give directions for this, as no two bodies will require exactly the same treatment. It is a matter of common sense and experience, and the medical officer will advise you.

Sponge all cavities until dry. The organs, such as the brain, lungs, heart, and those of the abdominal cavity usually have been removed. It is best not to return them to the body before closing. Instead fill the cavities with absorbent cotton soaked in embalming fluid. If important bones have been removed, pieces of wood can be wired in their place. When the skull has been opened to examine the brain, special care must be exercised to prevent the skullcap from slipping after the scalp has been sewed. This can be done by means of sutures (stitches) through soft parts or drill holes before closing the skin. Double-ended tacks are also useful for the purpose. If the body is

not embalmed or dressed immediately, cover with a clean sheet as at the start of the examination.

Embalming usually is done at about this stage, probably most satisfactorily before the openings have been closed. The remains then are prepared for burial by dressing and placing in the casket or coffin. Full directions for these procedures are given in the section on embalming, as well as in the Manual of the Medical Department, U. S. Navy, 1922, section 3 of chapter 19. Circular letters concerning them also appear from time to time from the Bureau of Medicine and Surgery. You must study the directions given, and be able to follow them implicitly.

It can not be emphasized too strongly that every care must be exercised to make the body presentable. Probably no other single thing, when not perfectly done, can occasion more distress to friends and relatives, and cause more trouble for those responsible. Friends and relatives are extremely critical, and you must spare no precautions that may prevent criticism. Use the razor upon those who have been accustomed to shaving as you would for yourself. Wash the body with soap and water until clean. It is well to give the hair a shampoo. Clean and trim the nails. And a few toilet articles, such as a little talcum and something to make the hair lie smoothly, are of real help. Arrange the hair so as to hide any cuts that have been made in the scalp. Clothing and linen must be clean and neat, and should be arranged so as to hide features that may be distressing.

After the work in connection with the body is completed, the room and equipment must be cleaned and put in order. This is largely an ordinary cleaning procedure. The care of certain articles of equipment already has been specified. Your instruments should be in perfect condition before storage, and covered with a thin coat of vaseline. If you leave them thus, you avoid trouble in case they are needed in a hurry. If the post-mortem examination has been of a person dead from a contagious or infectious disease, the usual precautions listed elsewhere in this book must be observed—the room, contents, and yourself being treated or disinfected to prevent spread of the disease. An occasional fumigation is a useful routine measure.

Mention has been made of an outfit for tissues or fluids that are to be saved for microscopical examination or for preservation of large specimens. For the latter purpose you will receive instructions from the medical officer. Usually they are carried to the laboratory in trays, closely covered. You can, however, keep certain things on hand for the specimens for microscopical examination, and by so doing will save much trouble, because the decision to save something usually will be made on the spot and the incidentals will be wanted in a hurry.

It may be desired to secure some sample, usually fluid, under aseptic precautions, and therefore certain articles of the equipment must be stored in sterile condition. A free flame, such as that of a Bunsen burner, is of use under such circumstances. Between it and the tincture of iodine, that you have on hand for wounds, there should be no difficulty in securing a suitable specimen.

The list of articles given below usually will handle the situation. It is well, however, to consult the medical officer in charge of the laboratory on the subject, as he may have some other preference.

One test-tube rack.

Ten test tubes, sterile, and plugged with cotton.

Twenty slides, glass (clean, flamed, and protected from dirt).

One platinum loop, in a handle.

Twelve sterile swabs, two packages of six each. (Wooden applicators with a small amount of cotton wrapped around one end. Make a muslin-covered package and sterilize.)

Syringes, all glass, 10 c. c. capacity, in sterile package. (One syringe with two large-bore needles in each package. The needles should contain their wires.)

Ten bottles, wide-mouthed, of about 50 c. c. capacity, with corks.

One bottle, containing 1,000 c. c. of 10 per cent formalin (liquor formaldehydi). (For use in the bottles above for the preservation of *small* pieces of tissue.)

Pencil, wax. (For writing upon glass.)

The occasion also arises when it is necessary to preserve portions of the corpse for chemical examination, usually for poisons. This is practically always a legal matter and the procedure must be surrounded with every precaution. Either accidentally or intentionally, there may be tampering with the specimens; therefore every care must be exercised to have them reach the chemist in proper condition—nothing having been added to them or removed from them. Not only must the medical officer and yourself be satisfied as to this, but you must be able to convince a jury. This can be accomplished only when all concerned can, upon their oath, testify that the necessary precautions have been observed.

It follows that your work must be protected by seals, and at that a seal that can not be imitated readily or one that can be used only by those in authority. Unauthorized tampering with the specimens then would be known. One also must try to permit no opportunity for the same by means of the strictest safeguarding under lock and key.

A medical officer ordinarily will supervise your work in this connection. It is well, however, always to be prepared for the emergency. It often comes unexpectedly and the containers can not be prepared at a moment's notice. Many precautions are necessary for this. So prepare them in advance and seal them effectively. Seal them in a package and keep them under lock and key.

The organs that practically always are saved for chemical examination are the stomach and duodenum with their contents, the intestines, the liver, the kidneys, and the brain. Often, also, other organs as well as the urine—in fact, any portion of the body may be saved for chemical examination. So you must have containers large enough to hold such material. There should be a bottle or jar for each organ to be saved, and the different organs should be placed in separate containers—not all together. The containers must be thoroughly washed with soap and water, treated with strong sulphuric acid, and finally, *thoroughly* rinsed with distilled water. When prepared wrap each one separately in firm, stout paper and secure the paper with tape or stout twine passed over and around the jar several times and in all directions. Seal each package with wax at many points.

A reasonable outfit then will consist of the following:

Ten jars, wide-mouthed, preferably glass-stoppered, assorted sizes. (There should be no rubber or metal at the joints or elsewhere that could come in contact with the contents. Joints are closed with paraffin, after the specimens are in the jars.)

Five bottles, glass-stoppered, assorted sizes from 1,000 c. c. capacity down.

Five catheters, new, of assorted sizes. (These are to be cleaned in the same manner as the glassware and stored similarly in perfectly clean bottles. They are used for securing the urine or other fluids.)

Distilled water. (Secure a large bottle for the purpose from the laboratory the same day as the examination.)

Paraffin. (Several cakes.)

Rinse the containers with distilled water just before the material is placed in them. Then they are covered, the joints closed with a very liberal amount of paraffin, labeled, and immediately sealed as before. If they are to be kept for a time or shipped some distance the best practice is to keep them constantly at as low a temperature as possible. If this can not be done a liberal quantity

of pure 95 per cent alcohol should be added to the contents and 500 c. c. of the same alcohol placed in a perfectly clean bottle and sent with them.

Make an inventory of the number and contents of each container. A copy of the inventory is sent along when a duly authorized person makes the shipment and a copy of the imprint of the seal should be included.

The matter of shipping specimens of medical interest is not as simple as one might think. The express companies and the postal authorities place many restrictions upon such packages, and one may get into trouble if he violates the regulations. Therefore before making such a shipment be sure that you are doing it properly. Consult the local express company. The Manual of the Medical Department, U. S. Navy, 1922, section 2, chapter 22, discusses the matter, especially as regards the mails. It would be a waste of space to repeat it here, but you must familiarize yourself with the contents of the Manual in this connection.

REFERENCES.

Medical Jurisprudence—Edwin W. Dwight.

A Textbook of Legal Medicine and Toxicology.—Peterson and Haines.

Recruiting.¹

For the Navy to carry on its work efficiently, it is necessary to have and maintain a capable and efficient personnel. A large percentage of the commissioned officers are supplied by the Naval Academy; some of the commissioned officers and most of the warrant officers and enlisted men are supplied originally by the Navy recruiting stations.

In order that enlistment may be possible to all without the necessity of traveling long distances from their homes for the purpose of examination, recruiting stations are located in various large cities throughout the United States.

The efficiency of the Navy is dependent on the men accepted at the various recruiting stations. If only ambitious, capable, healthy men of good character are accepted, the possibilities for efficiency are unlimited; otherwise there will be many misfits and more or less friction and inefficiency.

Generally the complement of a recruiting station consists of:

(1) The officer in charge of the station, usually a line officer who has been in the Navy a number of years.

(2) The medical officer, whose duty it is to examine carefully every applicant as to his physical and mental fitness and adaptability for the Navy.

(3) One or two yeomen for the regular office work.

(4) A hospital corpsman, usually a chief pharmacist's mate or pharmacist's mate, first class, who assists the medical officer in all examinations and in making out health records and other medical department reports and returns.

(5) A varying number of petty officers, who are known either as salesmen, canvassers, or outside men. These men are the ones who solicit the prospective recruit and carry on the general salesmanship, commonly spoken of as "selling the Navy." These men may be stationed at the main recruiting station or in some distant city in charge of a substation. Before being sent to a substation the men are given an intensive course of instruction on the physical examination of recruits by the medical officer at the main station. This is done in order that only men physically fit will be sent to the main station for final examination and acceptance.

¹ Prepared by Lieut. T. O. Summers, Medical Corps, United States Navy.

The duties of a hospital corpsman at a recruiting station are entirely different from any other type of duty. His principal duties are at the main office, where he assists in the examinations and does the clerical work of the Medical Department. The medical officer is the only one authorized to make physical examinations. The hospital corpsman prepares the applicant for examination, assists in weighing, taking height, chest measurements, color tests, testing vision and hearing, and recording on the proper form all scars found on the applicant. He takes the applicant's finger prints, usually after the medical officer has completed the examination.

While doing this work the hospital corpsman has an excellent opportunity to get an insight into the general habits of the man; the applicant frequently telling him things that he withholds from the recruiting or medical officer. Thus, the hospital corpsman sometimes can render valuable assistance in helping recognize cases of undesirables attempting to enlist.

To protect the interests of the Navy and be sure that only desirable men are accepted, everyone must work together in accordance with definite principles, each endeavoring to help the other in selecting only suitable men. The previous experience of hospital corpsmen in the hospitals, sick bays, and on general duty, ashore and afloat, usually is a most valuable asset. If they have any doubt as to the applicant's fitness for the service, they should give such information to the medical officer.

Each medical officer has a definite plan for conducting the examination in which all the requirements set down in Navy Regulations and the Manual of the Medical Department are complied with. It is necessary that the hospital corpsmen familiarize themselves with these instructions so that they may render all possible assistance with a minimum of delay.

The medical property of the station must be safeguarded and all reports sent in promptly. Some dispensing and, at times, attendance on men attached to the station who are sick in their quarters is required. As a rule, such men are transferred to a naval or a civilian hospital, but this is not always practicable.

In the general activities of a recruiting office it often is necessary to assist and receive assistance. That the work may run smoothly, each man should familiarize himself with all the work being done at the stations, thus promoting general cooperation and efficiency. The hospital corpsman should be able to carry on the yeoman's work should he be sick or on leave, and the yeoman, in turn, should be able to take up the work of his coworker. This is practical and can be done without friction.

A varying number of men are needed for the Hospital Corps from time to time. In selecting desirable men for this branch of the service, the hospital corpsman at the recruiting station can do valuable work for the Navy. He can be a salesman in the city and can help interest those applying at the main station with no definite rating in mind.

Should hospital corpsmen on recruiting duty be interested in any special work, such as X-ray or laboratory work, there are specialists in most cities who are glad to give, without charge, special opportunities for instruction and experience. Usually the assistance received is considered as covering the fees for this instruction.

From the above a general idea can be gathered as to what is expected of men at the recruiting station during office hours. However, their duties are not ended when they leave the office and much is expected of them in mingling with the civilian population after office hours.

As many of the recruiting stations are in inland cities, few of the people met with know much about the general activities of the Navy. The opinion many people have of Navy men in general is based upon the few they meet personally. Therefore, men on recruiting duty at all times must be most careful as to their general appearance and conduct. Subsistence being provided, living quarters in a desirable section of the city should be chosen, and every effort made to meet and form intimate friendships with people of culture.

That he may be able to talk to them intelligently and give definite answers to any questions concerning the Navy, the man on recruiting duty should familiarize himself with all the activities of the Navy, know about the different trade schools open to enlisted men and the opportunities available for learning a trade; also the average advancement in ratings and pay.

In addition to the knowledge gained by personal experience, men detailed to recruiting duty should read all the literature on recruiting, published by the Bureau of Navigation and attend all instructions given salesmen by the officer in charge of the station.

Applicants generally believe that the men on recruiting duty are in the Navy from choice and conscientiously can recommend such a career to those with whom they come in contact. Only those men who have been in the Navy a number of years, and are convinced that the opportunities offered justify them in recommending the Navy for a career, are fitted for this important duty. Such men are usually ambitious and capable, their conduct is above reproach, and they can be trusted to do the proper thing at all times. Their conduct reflects honor on the Navy at all times, and they attract men of a similar type, interesting them to the extent that many, appreciating the opportunities offered, apply for enlistment in the Navy.

CHAPTER XII.

ADMINISTRATION.¹

General Plan, Arrangement, and Management of Naval Hospitals.

From a legal standpoint, naval medical facilities can be designated as a "hospital" only when they have been specifically established as such under an appropriation by Congress. However, field hospitals and Navy base hospitals for foreign duty, may, by competent authority, be classified as naval hospitals. All other medical facilities can be designated as dispensaries.

The ever-forward advancement made in hospital construction reflects itself in the many types of architecture found in our naval hospitals, but the floor plan as here illustrated is considered by the Bureau of Medicine and Surgery as an excellent arrangement for a hospital. This arrangement, adopted a number of years ago, still has the hearty approval of the Bureau of Medicine and Surgery. While many of the utility rooms which were designed originally for a particular purpose are not used as such at the present time, the general plan of the hospital has not been altered materially.

In its general outline this type of hospital resembles a "T." The administration building occupies the front and center, with the wards situated on each side and the operating and subsistence building in the rear, all of which are connected to the central buildings by corridors.

In the basement are located various storerooms, disinfecting plant, recreation, hydrotherapeutic, wash, toilet, and X-ray rooms, kitchen, dispensary, laboratory, etc.

On the first floor are the administrative and executive offices, two wards with dressing, quiet, and toilet rooms, diet kitchen, and solaria attached, and the general mess hall and pantry are to the rear of the central building.

On the second floor are two wards—counterparts of the wards below—rooms, toilets, dining rooms for sick officers, a dressing room, a room for nurses, and a diet kitchen. In the rear are the operating, sterilizing, etherizing, dressing, wash, and recovery rooms.

On the third floor are rooms and toilets for sick officers, a dressing room, a room for nurses, a diet kitchen, and a large reception room; also other utility rooms.

In addition to the main, or hospital building, each hospital is equipped with other buildings necessary for the proper maintenance of the hospital, such as quarters for staff, power plant, laundry, garage, etc.

The modern hospital of to-day is divided into the following services: Administration, surgical, medical, specialists, and laboratory (bacteriological, serological, and X-ray). These departments directly concern the treatment afforded its patients. Except for a brief general consideration of the administration of naval hospitals, none of these services will be discussed in this

¹ Prepared by Chief Pharmacist H. L. Gall, United States Navy.

section. For a complete description see Chapter XII, Manual of the Medical Department.

Naval hospitals are commanded by an officer of the Medical Corps of the United States Navy, usually of the rank of captain, who is responsible to the Bureau of Medicine and Surgery for the care and treatment of the patients and for the discipline, cleanliness, and economic management of the institution, and in return exacts from subordinates, employees, and patients a proper obedience to his orders and to the laws and regulations of the Navy. All persons belonging to the Navy or Marine Corps who may be attached to the hospital or civilian employees in the hospital perform such duties as may be assigned to them by the commanding officer. The general policies regarding the administration of naval hospitals are formulated in the Navy Department, but the commanding officer is responsible to the Bureau of Medicine and Surgery for the accomplishment of these policies in such manner as he may deem most suitable to local conditions. The general orders regarding the

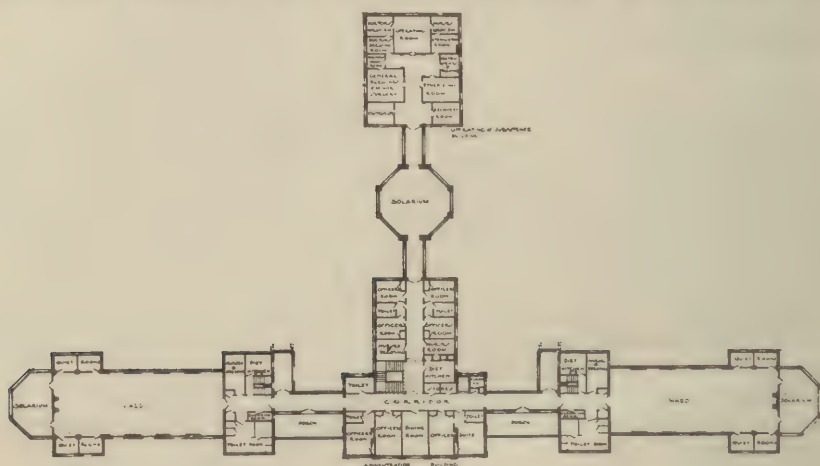


FIG. 202.—Floor plan of "T" type naval hospital.

operation of a naval hospital are in the main very similar at all institutions, as they are governed by the policies of the Navy Department; but the working details of these policies differ at the various hospitals, due to location, capacity, arrangement, etc. The policies of the Bureau of Medicine and Surgery and the Navy Department are sufficiently flexible to allow for these varying conditions, and over which the commanding officer is given complete control.

The medical officer next in rank to the commanding officer, unless otherwise ordered by the Navy Department, performs the duties of executive officer of the hospital. He is responsible to the commanding officer for the general functioning of the institution. The orders issued by the executive officer are the orders of the commanding officer, therefore he always is well informed concerning the orders and policies of the commanding officer. Subject to the approval of the commanding officer, the executive officer directs all matters as regards duty assigned to personnel, discipline, leave, liberty, cleanliness, good order, etc., of the hospital. As he is the direct representative of the commanding officer, all requests or communications of any nature intended for the commanding officer must be taken up with him before being submitted to the

commanding officer. Military etiquette demands that permission be obtained from the executive officer to communicate directly with the commanding officer. This is done in order that the executive officer may be informed regarding all matters pertinent to his office and at times relieve the commanding officer of minor details which can be adjusted by him. In the absence of the commanding officer, the executive officer is recognized as the commanding officer and performs such duty during his absence.

All other medical officers attached to a naval hospital are designated as junior medical officers. They are assigned to the various activities of the hospital by the executive officer with the approval of the commanding officer. The assignment of these officers to duty in the wards, operating room, X-ray department, laboratory, etc., places them in charge of work performed within the activity concerned, and they are directly responsible to the executive and commanding officers for the proper performance of their duties, and in turn exact of the hospital corpsmen and nurses under them strict attention to duty and proper performance of all orders issued by the commanding officer. The junior medical officers alternate in duty as officer of the day. An officer so acting is the representative of the commanding officer and is responsible to him for compliance with orders and the maintenance of good order and discipline in the hospital. If the commanding officer and executive officer be absent from the hospital, he is responsible for the efficient management of the hospital and has the authority necessary for the enforcement of the orders and regulations governing the hospital during their absence. In the absence of an officer assigned as a ward officer, the officer of the day is charged with the proper care of the sick in the ward concerned, and all information regarding patients, which under ordinary conditions would be taken up with the ward officer, is communicated to the officer of the day, who issues orders accordingly. Hospital corpsmen take up all matters pertaining to the treatment of patients directly with the medical officer of the ward, or in his absence the officer of the day, and all details regarding patients' liberty, leave, work, etc., must be approved by the ward officer before being submitted to the executive officer. All patients admitted to a naval hospital are received by the officer of the day or his representative; he also is informed of all discharges involving patients; and all attachments, transfers, or discharges of staff must be passed through him.

The duty of replenishment of supplies, the upkeep, expenditure, accountability, and survey of property, management of the commissary department, and the correspondence and clerical work of the administrative offices of a naval hospital is performed by chief pharmacists and pharmacists. However, the commanding officer may direct that these officers perform other duties not mentioned here. In order to accomplish this work, hospital corpsmen and civilian clerks are detailed in the offices concerned, under the direct charge of the pharmacist. In connection with the accountability of property great care has to be exercised at all times by hospital corpsmen, as it must be remembered that all equipment and supplies of the medical department are Government property and the laws governing their care and preservation are stringent and binding.

Hospital corpsmen may be detailed for duty in any activity of the hospital as the commanding officer may direct. As it is the policy of the Bureau of Medicine and Surgery that hospital corpsmen's duty shall be such as pertains directly with the care of the sick, all hospital corpsmen on duty in a naval hospital should thoroughly acquaint themselves with the orders and regulations governing the hospital, in order that they can carry out faithfully such duties

as may be assigned them and that all instructions concerning the treatment of patients consigned to their care be conscientiously accomplished. A chief pharmacist's mate customarily is detailed for duty as the master at arms of the hospital. He is responsible to the executive officer, and in his absence to the officer of the day, for such duties as may have been assigned him by the executive officer as regards the maintenance of discipline and order in the hospital and the various utility buildings of the hospital. From a layman's viewpoint, the duties of a hospital corpsman at naval hospitals may, at times, seem disagreeable, but such duties are often most important from a nursing standpoint, and the accomplishment of such duties in the manner directed by the medical officer concerned will make much for the efficiency of the hospital and will be recognized only as part of that intricate machinery called management.

The nursing service of a naval hospital is under the direct supervision of the chief nurse. She instructs nurses in their duties, particularly as they pertain to the naval service, and sees that the orders of the executive officer and ward officers are performed by the nurses under her. Nurses in charge of wards, operating rooms, diet kitchens, or linen rooms are given the necessary authority over patients and hospital corpsmen for the purpose of direct care of the sick and of ward or other work. They are held responsible for their conduct, attention to duty, and practical instruction in the details assigned to them. The work assigned hospital corpsmen in our naval hospitals is considered as a training for the work to follow when they are assigned to duty on board men-of-war and on independent duty, when the instructions obtained in the hospital will be fully appreciated.

Civil employees at naval hospitals are divided into groups under different departments of the institution, the heads of each group being responsible to the executive officer for the proper performance of duty.

The hospital has various special departments, such as dispensary, linen room, diet kitchen, etc., which are indirectly concerned in the treatment of the sick, but are necessary adjuncts to the hospital. These departments are in direct charge of a nurse or hospital corpsman, who is responsible to the executive officer for the proper performance of duty as directed by the commanding officer.

Organization, Clerical Duties and Procedures.¹

Upon the officers and enlisted men of the Hospital Corps the medical department of the Navy depends largely for the proper performance of routine administrative and clerical duties. Though the most important duty of the Hospital Corps is the care and comfort of the sick and wounded, as advancement in rating occurs its members necessarily become more familiar with the administrative and clerical duties essential to a proper performance of the duties with which the medical department is charged, and assume responsibility not only for the accuracy of this work but for so organizing and supervising the clerical force that a maximum of efficiency is maintained.

To satisfactorily perform these duties, hospital corpsmen must:

(1) Be conversant with the Navy as regards its organization and personnel, its history, and the laws and regulations governing the Naval Establishment;

(2) Be thoroughly familiar with the history and organization of the medical department, the laws and regulations governing its duties, the sources and application of monies under its control, and the relationship of the medical department to the Naval Establishment;

¹ Prepared by Chief Pharmacist N. L. Saunders, United States Navy.

(3) Have a full knowledge of the duties of the medical department ashore in naval hospitals and at other shore stations and afloat on the various types of vessels forming the fleets;

(4) Understand office management and the Navy Regulations and bureau manuals governing the performance of clerical and administrative duties.

DEPARTMENT OF THE NAVY.

The President, by the Constitution, is the Commander in Chief of the Navy.

The Navy Department is one of the ten executive departments of the United States Government, and is charged with the general control and administration of the Navy.

At the head of this department is the Secretary of the Navy, a civil officer, and a member of the Cabinet. He is appointed by the President, by and with the advice and consent of the Senate, and performs such duty as the President of the United States may assign him and has the general superintendence of construction, manning, armament, equipment, and employment of vessels of war.

The Secretary's deputy is the Assistant Secretary of the Navy.

NAVY DEPARTMENT BUREAUS.

For purposes of administration and distribution of duties the Navy Department is divided into the Office of Naval Operations and eight bureaus, each charged with certain specific duties and in charge of an officer of the Navy appointed by the President of the United States, by and with the advice and consent of the Senate. The chiefs of the several bureaus of the Navy Department are appointed for four years and have the rank of rear admiral (upper half) while performing such duties. They receive the pay and allowances of a major general in the Army. The chief of naval operations holds the rank of admiral.

Following is a list of these bureaus and the title of officers in charge of them:

Office of Naval Operations_____	Chief of Naval Operations.
Navigation_____	Chief of the Bureau.
Yards and Docks_____	Chief of the Bureau.
Ordnance_____	Chief of the Bureau.
Construction and Repair_____	Chief Constructor and Chief of the Bureau.
Engineering_____	Engineer in Chief and Chief of the Bureau.
Medicine and Surgery_____	Surgeon General and Chief of the Bureau.
Supplies and Accounts_____	Paymaster General and Chief of the Bureau.
Aeronautics_____	Chief of the Bureau.

These are charged with the following duties:

Office of Naval Operations.

During the temporary absence of the Secretary and the Assistant Secretary of the Navy the Chief of Naval Operations is next in succession to act as Secretary of the Navy. (Act March 3, 1915.) The Chief of Naval Operations, while so serving as such, has the rank and title of admiral, to take rank next after the Admiral of the Navy (act August 29, 1916).

The Chief of Naval Operations, under the direction of the Secretary of the Navy, is charged with the operations of the fleet and with the preparation and readiness of plans for its use in war. (Act March 3, 1915.) This includes the direction of the Naval War College, the Office of Naval Intelligence, the Office of Gunnery Exercises and Engineering Performances, the operation of the Radio Service and of other systems of communication, the operations of the Aeronautic Service, of Mines and Mining, of the Naval Defense Districts, Naval Militia, and of the Coast Guard when operating with the Navy; the direction of all strategic and tactical matters, organization, maneuvers, target practice, drills and exercises, and of the training of the fleet for war; and the preparation, revision, and enforcement of all tactics, drill books, signal codes, and cipher codes.

The Chief of Naval Operations is charged with the preparation, revision, and record of Regulations for the Government of the Navy and General Orders. He advises the Secretary concerning the movements and operations of vessels of the Navy and prepares all orders issued by the Secretary in regard thereto and keeps the records of service of all fleets, squadrons, and ships. He advises the Secretary in regard to the military features of all new ships and any proposed extensive alterations of a ship which will affect her military value; the location, capacity, and protection of navy yards and naval stations, including all features which affect the military value of dry docks, including their location; also as to matters pertaining to fuel reservations and depots, the location of radio stations, reserves of ordnance and ammunition, fuel, stores, and other supplies of whatsoever nature, with a view to meeting effectively the demands of the fleet. He furnishes the General Board with full information regarding them, and advises the Secretary on all business of the department in regard to foreign relations.

In preparing and maintaining in readiness plans for the use of the fleet in war he freely consults with and has the advice and assistance of the various bureaus, boards, and offices of the department, including the Marine Corps Headquarters, in matters coming under their cognizance. After the approval of any given war plans by the Secretary it is the duty of the Chief of Naval Operations to assign to the bureaus, boards, and offices such parts of these plans as may be needed for the intelligent carrying out of their respective duties in regard to them.

The Chief of Naval Operations is charged with matters pertaining to the operation of aircraft and from time to time witnesses the operations of the fleet as an observer.

He has two principal senior assistants, officers not below the grade of captain, one as assistant for operations and the other as assistant for matériel and he is ex officio a member of the general board.

Under the Office of Naval Operations are the following:

Communication Office.—The Director of Naval Communications is charged with matters pertaining to the operations of the entire radio, telegraph, telephone, and cable systems of communication within the naval service and is responsible for the handling of all telegraphic and radio communications to and from the Navy Department. In his administration of the foregoing he has general charge of the operation, organization, and administration of communication service. He cooperates with officials designated by the Secretary of Commerce in reference to the proposed location of commercial radio stations, the licensing of operators, the control of the operation of commercial radio stations under the law and the assignment of wave lengths for use by commercial stations which will comply with the law and prevent interference with the radio work of the naval communication service.

The communication office, under the Director of Naval Communications, handles all the despatch work of the Navy Department. A commissioned officer is on watch in the communication office at all times, night and day, and is responsible for the routing, coding, and decoding of all despatches. He is responsible for the proper delivery of all received official messages. The assistant communication officer on watch keeps himself informed of the general despatches received outside of departmental hours, and is responsible that despatches of importance requiring immediate action are communicated as soon as possible to the proper office.

Office of Naval Intelligence.—Under the Director of Naval Intelligence this office is charged with the collection, classification, publication, and dissemination of such information at home and abroad as will be useful to the Chief of Naval Operations and to the various bureaus of the Navy Department in the formulation of plans for war and in the development of personnel and matériel. It directs all naval attachés abroad and cooperates with other executive departments of the Government in bringing to justice persons engaged in activities against the United States.

Office of Gunnery Exercises and Engineering Performances.—The Office of Gunnery Exercises and Engineering Performances is charged with the duties, under the Chief of Naval Operations, of formulating and issuing to the service rules and instructions for all forms of gunnery and engineering exercises and operations; the collection, analysis, and review of data in regard to gunnery and steaming performances of naval craft; the review of battle inspections of ships for the Chief of Naval Operations in connection with the preparation and maintenance of the fleet for war.

Bureau of navigation.

The duties of the Bureau of Navigation comprise the issue, record, and enforcement of the orders of the Secretary to the individual officers of the Navy; the training and education of line officers and of enlisted men (except those of the Hospital Corps) at schools and stations and in vessels maintained for that purpose; the upkeep and operation of the Naval Academy, of technical schools for line officers, of the apprentice-seaman establishments, of schools for the technical education of enlisted men and of the Naval Home at Philadelphia, Pa.; the upkeep and payment of the operating expenses of the Naval War College; the enlistment, assignment to duty, and discharge of all enlisted persons. It has under its direction the organization and administration of the Naval Reserve Force and provides for its mobilization, and provides transportation for all enlisted persons under its cognizance.

It establishes the complement of all ships in commission and shore stations and keeps the records of service of all officers and men, preparing an annual Navy Register for publication, embodying therein the data as to fleets, squadrons, and ships which are furnished by the Chief of Naval Operations. In order that the provisions of this paragraph may be carried out, all communications to or from ships in commission relating to the personnel of such ships are forwarded through this bureau, whatever their origin.

It is charged with all matters pertaining to applications for appointments and commissions in the Navy and with the preparation of such appointments and commissions for signature.

It is charged with the preparation, revision, and enforcement of all regulations governing uniform, and the distribution of all orders and regulations of a general or circular character.

Questions of naval discipline, rewards, and punishments are submitted by this bureau for the action of the Secretary of the Navy. The records

of all general courts-martial and courts of inquiry involving the personnel of the Navy before final action are referred to this bureau for comment as to disciplinary features. It receives and brings to the attention of the Secretary of the Navy all applications from officers for duty or leave.

It receives all reports of services performed by individual officers or men, and is charged with the enforcement of regulations and instructions regarding naval ceremonies and naval etiquette.

It is charged with the upkeep and operation of the Hydrographic Office, the Naval Observatory, Nautical Almanac, and compass offices, and with all that relates to the collection, dissemination, and supply of navigational data and the supply and upkeep of navigational instruments. It has charge of all ocean and lake surveys and ships' and crews' libraries; it defrays the expenses of pilotage of all ships in commission.

Under the Bureau of Navigation are the following:

Naval Observatory.—The Naval Observatory at Washington, D. C., and the Navy Chronometer Time Station at the navy yard, Mare Island, Calif., furnish the country with the standard time each day, both by telegraph and radio, and the adjacent oceans by radio, the former supplying that part of the country east of the Rocky Mountains and the latter that part west. The Naval Observatory supervises the outfits of instruments for the naval service and keeps up continuous fundamental observations of the heavenly bodies for the use of the Nautical Almanac Office, which prepares the American Ephemeris and Nautical Almanac each year for the use of navigators, surveyors, and others requiring the positions and movements of the heavenly bodies.

Hydrographic Office.—The Hydrographic Office is charged with marine surveys in foreign waters and with the collection and dissemination of hydrographic and navigational data; the preparation and printing of maps and charts relating to and required in navigation; the preparation of navigators' sailing directions or pilots, and manuals of instruction for the use of all vessels of the United States and for the benefit and use of navigators generally; the furnishing of the foregoing to the Navy and other public services; and their sale to the mercantile marine and the public at cost.

Bureau of Yards and Docks.

The duties of the Bureau of Yards and Docks comprise all that relates to the design and construction of the public works and public utilities of the Navy such as dry docks, marine railways, building ways, harbor works, quay walls, piers, wharves, slips, dredging, landings, floating and stationary cranes, power plants, coaling and fuel plants, heating, lighting, telephone, water, sewer, and railroad systems, roads, walks and grounds, bridges, radio towers, and all buildings, for whatever purpose needed, under the Navy and Marine Corps.

It provides for the upkeep and operation of the same, except at naval ordnance establishments, naval training stations, the Naval Observatory, the Naval War College and the Naval Academy, marine hospitals and medical supply depots, marine posts, radio stations, and the engineering experiment station. It designs and makes the estimates for public works after consulting as to their operating features with the bureau or office for whose use they are primarily intended. It has charge of all means of transportation, such as derricks, shears, locomotives, locomotive cranes, cars, motor trucks, and all vehicles, horses, teams, and necessary operators and teamsters in the navy yards and naval stations. It provides the furniture for all buildings, except at the naval magazines, hospitals, the Naval Academy, and marine posts. It provides clerks for the offices of the commandant, captain of the yard, and public works officer. In

general, the work of the bureau is carried out by commissioned officers of the Corps of Civil Engineers, United States Navy, whose major duties comprise the construction and maintenance of the public works of the Navy.

Bureau of Ordnance.

The duties of the Bureau of Ordnance comprise all that relates to the upkeep, repair, and operation of the naval gun factory, naval ordnance plants, naval torpedo stations, naval proving grounds, naval ammunition depots, naval magazines on shore, and naval mine depots; to the manufacture of offensive and defensive arms and apparatus (including torpedoes and armor), all ammunition, and war explosives. It requires for or manufactures all machinery, apparatus, equipment, material, and supplies required by or for use with the above.

It determines the interior dimensions of revolving turrets and their requirements as regards rotation.

As work proceeds it inspects the installation of the permanent fixtures of the armament and its accessories on board ship, and the methods of stowing, handling, and transporting ammunition and torpedoes, all of which work must be performed to its satisfaction. It designs and constructs all turret ammunition hoists, determines the requirements of all ammunition hoists, and the method of construction of armories and ammunition rooms on shipboard, and in conjunction with the Bureau of Construction and Repair, determines upon their location and that of all ammunition hoists outside of turrets. It installs all parts of the armament and its accessories which are not permanently attached to any portion of the structure of the hull, excepting turret guns, turret mounts, and ammunition hoists, and such other mounts as require simultaneous structural work in connection with the installation or removal. It confers with the Bureau of Construction and Repair respecting the arrangements for centering the turrets and character of the roller paths and their supports.

It has cognizance of all electrically operated ammunition hoists, rammers, and gun-elevating gear in turrets; of electric training and elevating gear for gun mounts not in turrets; of electrically operated air compressors for charging torpedoes; and of all range finders and battle-order and range transmitters and indicators.

Bureau of Construction and Repair.

The duties of the Bureau of Construction and Repair comprise the responsibility for the structural strength and stability of all ships for the Navy; all that relates to designing, building, fitting, and repairing the hulls of ships, turrets, and electrical turret-turning machinery, spars, capstans, windlasses, deck winches, boat cranes, steering engines and telemotors therefor, and hull ventilating apparatus (except portable fans); and, after consultation with the Bureau of Ordnance and according to the requirements thereof as determined by that bureau, the designing, construction, and installation of independent ammunition hoists, the same to conform to the requirements of the Bureau of Ordnance as to power, speed, and control, and the installation of the permanent fixtures of all ammunition hoists and their appurtenances; placing and securing armor; placing and securing on board ship, to the satisfaction of the Bureau of Ordnance, the permanent fixtures of the armament and its accessories as manufactured and supplied by that bureau; installing the turret guns, turret mounts, and turret ammunition hoists, and such other mounts as require simultaneous structural work in connection with installation and removal. It also

designs, after conference with the Bureau of Ordnance, the arrangements for centering the turrets, the character of the roller paths and their supports. The Bureau of Ordnance is afforded every opportunity to inspect the installation of the armament and accessories supplied by that bureau.

It has charge of the docking of ships and is charged with the operating and cleaning of dry docks.

It is responsible for the care and preservation of ships not in commission.

It has cognizance of electric launches and other boats supplied with electric motive power.

It has charge of the manufacture of anchors and cables; the supplying and fitting of rope, cordage, sails, awnings, and other canvas, and flags and bunting; it supplies to the satisfaction of the Bureau of Supplies and Accounts galley ranges, steam cookers, and other permanent galley fittings, and installs and repairs the same.

It supplies and installs in consultation with the Bureau of Engineering, all voice tubes and means of mechanical signal communications.

Bureau of Engineering.

The duties of the Bureau of Engineering comprise all that relates to designing, building, fitting out, and repairing machinery used for the propulsion of naval ships; the steam pumps, steam heaters, distilling apparatus, refrigerating apparatus, all steam connections of ships, and the steam machinery necessary for actuating the apparatus by which turrets are turned.

It inspects all fuel for the fleet and has cognizance of the entire system of interior communications. It is specifically charged with the design, supply, installation, maintenance, and repair of all means of interior and exterior electric signal communications (except range finders and battle-order and range transmitters and indicators), and of all electrical appliances of whatsoever nature on board naval vessels, except motors and their controlling apparatus used to operate the machinery belonging to the other bureaus.

It supplies and installs all conduit and molding or plans for such installation after consultation with the Bureau of Construction and Repair and subject to the approval of that bureau.

It has supervision and control of the upkeep and operation of the engineering experiment station.

It designs the various shops at navy yards and stations where its own work is executed so far as their internal arrangements are concerned.

Bureau of Medicine and Surgery.

"The Bureau of Medicine and Surgery shall have charge of the upkeep and operation of all hospitals and of the force employed there; it shall advise with respect to all questions connected with hygiene and sanitation affecting the service and, to this end, shall have opportunity for necessary inspection; it shall provide for physical examinations; it shall pass upon the competency, from a professional standpoint, of all men in the Hospital Corps for enlistment, enrollment, and promotion by means of examinations conducted under its supervision or under forms prescribed by it; it shall recommend and have information as to the assignment and duties of all enlisted men of the Hospital Corps; it shall recommend to the Bureau of Navigation the complement of medical officers, dental officers, nurses, and hospital corpsmen for hospitals and hospital ships, and shall have power to appoint and remove all nurses in the Nurse Corps, subject to the approval of the Secretary of the Navy." (Art. 457 (1), N. R.)

"Except as otherwise provided for, the duties of the Bureau of Medicine and Surgery shall include the upkeep and operation of medical supply depots, medical laboratories, naval hospitals, dispensaries, technical schools for the Medical, Dental, and Hospital Corps; and the administration of the Nurse Corps." (Art. 457 (2), N. R.)

"It shall approve the design of hospital ships in so far as relates to their efficiency for the care of the sick and wounded." (Art. 457 (3), N. R.)

"It shall require for all supplies, medicines, and instruments used in the medical department of the Navy. It shall have control of the preparation, reception, storage, care, custody, transfer, and issue of all supplies of every kind used in the medical department for its own purposes." (Art. 457 (4), N. R.)

"The Bureau of Medicine and Surgery is charged with the duty of inspecting the sanitary condition of the Navy and making recommendations in reference thereto; of advising with the department and other bureaus in reference to the sanitary features of ships under construction and in commission; regarding berthing, ventilation, location of quarters for the care and treatment of the sick and injured; of all provisions for the care of the wounded in battle; and, in the case of shore stations, of advising in regard to health conditions, depending on location, the hygienic construction, and care of public buildings, especially barracks and other habitations, such as camps. It shall advise in regard to water supplies used for drinking, cooking, and bathing purposes, and drainage and the disposal of wastes, so far as these affect the health of the Navy. It shall provide for the care of the sick and wounded, the physical examination of officers and enlisted men, with a view to the selection or retention of those only whose physical condition is such as to maintain or improve the military efficiency of the service if admitted or retained therein, the management and control of naval hospitals and of the internal organization and administration of hospital ships, the instruction of the personnel of the Hospital Corps and Nurse Corps, and the furnishing of all medical and hospital supplies. It shall advise in matters pertaining to clothing and food so far as these affect the health of the Navy. It shall safeguard the personnel by the employment of the best methods of hygiene and sanitation, both afloat and ashore, with a view to maintaining the highest possible percentage of the personnel ready for service at all times. It shall adopt for use all such devices or procedures as may be developed in the sciences of medicine and surgery which will in any way tend to an increase in military efficiency." (Art. 458 (1), N. R.)

"All technical schools which are, or may be, established for the education of medical and dental officers or members of the Hospital Corps and Nurse Corps shall be under the supervision and control of the Bureau of Medicine and Surgery." (Art. 458 (2), N. R.)

Bureau of Supplies and Accounts.

The duties of the Bureau of Supplies and Accounts comprise all that relates to the purchase, reception, storage, care, custody, transfer, shipment, issue of, and accounting for all supplies and property of the Naval Establishment except medical supplies (but including their purchase) and supplies for the Marine Corps; the procuring of provisions, clothing, and small stores, and material under the Navy Supply Account. This fund, which is administered by the Bureau of Supplies and Accounts, governs the charging, crediting, receipt, purchase, transfer, manufacture, repair, issue, and consumption of all stores for the Naval Establishment except for a few items which are specifically exempted. The direction of naval clothing factories and their cost of operation also come under the control of this bureau.

It procures all coal and fuel for steamers' and ships' use, including expenses for transportation, storage, and handling the same; and water for all purposes on board naval vessels, including the expense of transportation and storage of the same.

The duties also comprise all that relates to the supply of funds for Navy disbursing officers; payment for articles and services for which contract and agreement have been made; responsibility for the keeping of the property and the money accounts of the Naval Establishment, including accounts of all manufacturing and operating expense at the navy yards and stations, the direction of naval cost accounting, and the audit of property returns.

It prepares the estimates for the appropriation for freight, fuel, provisions, and clothing for the Navy, the maintenance of the supply, accounting, and disbursing departments at navy yards and stations, and for the pay of all officers and enlisted men of the Navy.

Bureau of Aeronautics.

The duties of the Bureau of Aeronautics comprise all that relates to designing, building, fitting out, and repairing naval and Marine Corps aircraft, except that the bureau recommends to each bureau of the Navy Department the nature and priority of experimental development and production of aeronautical material under that bureau's cognizance.

When designs are to be prepared for a new type of aircraft the Bureau of Aeronautics has duties in respect to the General Board similar to those prescribed for the Bureau of Construction and Repair in article 402, United States Navy Regulations, 1920.

It makes special provision in its organization to enable it to furnish the information covering all aeronautic planning, operations, and administration that may be called for by the Chief of Naval Operations.

It makes recommendations to the Bureau of Navigation and the Major General Commandant, United States Marine Corps, for the detail of officers for duty in connection with aeronautics, for the distribution in the various ratings and ranks of the enlisted personnel required for aeronautic duties, and on all matters pertaining to aeronautic activities.

The Bureau of Aeronautics has cognizance over the policy of the upkeep and operation of:

- (a) Naval aircraft factories.
- (b) Naval aeronautic experimental stations.
- (c) Helium plants in so far as they come under naval cognizance.

Experimental and test work of other bureaus affecting aeronautical material is made in accordance with requests of the bureau. The installation of ordnance material and navigational instruments in aircraft and the repairs of public works utilities at aeronautic shore establishments, their upkeep and operation are under the cognizance of the Bureau of Aeronautics.

The Judge Advocate General of the Navy.

Attached to the Secretary of the Navy's office is the office of the Judge Advocate General. The Judge Advocate General of the Navy is appointed by the President for four years, by and with the consent of the Senate, from officers of the Navy or Marine Corps, and, while so serving, has the rank of rear admiral (upper half) in the Navy or major general in the Marine Corps, as the case may be.

In accordance with the statute creating his office, the Judge Advocate General is charged with the handling and has cognizance of all matters of law arising

in the Navy Department. This includes the revision and reporting upon the legal features and recording of the proceedings of all courts-martial, courts of inquiry, boards of investigation and inquest, and boards for the examination of officers for retirement and promotion in the naval service; the preparation of charges and specifications for general courts-martial; the preparation of precepts for and the making of changes in membership of departmental examining boards, retiring boards, courts of inquiry, boards of investigation, and general courts-martial; the preparation of court-martial orders promulgating the final action of the reviewing authority in general court-martial cases, except those of enlisted men convened by officers other than the Secretary of the Navy; the examining and reporting upon all questions relating to rank and precedence, to promotion and retirement, to the administration of naval prisons and prisoners, including prisoners of war, to removal of the mark of desertion, to correction of records of service of naval personnel, to pardons and to certification of discharge in true name; the interpretation of statutes; the drafting of proposed legislation originating in the Navy Department; the examination and reporting upon all bills and resolutions introduced in Congress and referred to the Navy Department for report; proceedings in civil courts by or against the Government or its officers; the summoning and subpoenaing of witnesses; the preparation of and handling of questions of law relating to advertisements, proposals and contracts, insurance, leases, patents, the sufficiency of official contracts, bonds, and other guaranties; claims by or against the Government; and the conducting of correspondence relating to the above, including the preparation for submission to the Attorney General of all questions which the Secretary of the Navy may direct to be so submitted.

It is also the duty of the Judge Advocate General to investigate and report upon all questions relating to pay and allowances of naval personnel and prepare references to the general accounting officers of the Treasury; and to study international law and examine and report upon questions of international law as arising.

He is charged, under the special instructions of the Secretary of the Navy, with the searching of titles, purchase, sale, transfer, and other questions affecting lands and buildings pertaining to the Navy and with the care and preservation of all muniments of title to land acquired for naval purposes. The correspondence respecting the foregoing duties, and rendering opinion upon the matter or question of law referred to him by the Secretary or Assistant Secretary of the Navy.

PERSONNEL OF THE NAVY.

To comprehend clearly matters pertaining to the personnel of the Navy it is necessary to understand the general divisions of this personnel and the several corps comprising it, as well as the different ranks and grades of the officers and the many ratings held by the enlisted men.

The personnel of the Navy is composed of officers and enlisted men, their numbers varying in accordance with the authorized strength of the Navy allowed by law or by funds appropriated for pay of the Navy, and regulated largely by service requirements.

An officer is one appointed to a certain rank and authority by the President of the United States by and with the advice and consent of the Senate. In the Navy an officer is appointed by either commission or warrant. This divides the officers as a whole into two classes, commissioned officers and warrant officers.

An officer's tenure in the Navy is for life, unless sooner terminated by removal, resignation, disability, or other casualty.

The enlisted men of the Navy, as the term indicates, are enlisted or engaged for periods of service and discharged from the service at the expiration of such enlistment. At the expiration of an enlistment they can reenlist or extend the current enlistment for a variable period of from one to four years.

Commissioned officers of the line.

Commissioned officers of the line are those who succeed to a command and who automatically assume command in order of seniority, even in the presence of staff officers of a higher rank.

Officers of the line in the Navy, with few exceptions, are graduates from the United States Naval Academy at Annapolis, Md., where they receive training by the Government in the duties essential to naval science.

While attending the Naval Academy they rank as midshipmen; midshipmen, though not commissioned, enjoy certain privileges and consideration as officers of the Navy. Upon graduation midshipmen are commissioned ensigns.

The commissioned officers of the line in the Navy have the rank of admiral, vice admiral, rear admiral, captain, commander, lieutenant commander, lieutenant, lieutenant (junior grade) and ensign, corresponding to the ranks of general, lieutenant general, major general, colonel, lieutenant colonel, major, captain, first lieutenant, and second lieutenant, respectively, in the Army.

Commissioned officers of the staff.

The staff is a body of officers, not succeeding to command but entrusted with special duties peculiar to their training. They may be classed as specialists by reason of the training in particular professions received, in civil life, by most of them, and are appointed in the Navy after passing a professional examination. An exception to this is the Naval Construction Corps, which is made up principally of officers selected from the graduates of the Naval Academy.

The commissioned staff of the Navy comprises medical officers, dental officers, supply officers, chaplains, professors of mathematics, naval constructors, and civil engineers. These officers are divided into corps in accordance with the designation of their professions as indicated, i. e., Medical Corps, Dental Corps, Supply Corps, Corps of Chaplains, Corps of Professors of Mathematics, Construction Corps, and Civil Engineer Corps.

The Medical and Dental Corps of the Navy, of particular interest to hospital corpsmen, are comprised of medical and dental officers having the following grades and ranks:

Medical Director.....	} Rear Admiral.
	} Captain.
Medical Inspector.....	Commander.
Surgeon.....	Lieutenant Commander.
Passed Assistant Surgeon.....	Lieutenant.
Assistant Surgeon.....	} Lieutenant (junior grade).
Acting Assistant Surgeon.....	
Dental Surgeon.....	Lieutenant Commander.
Passed Assistant Dental Surgeon.....	Lieutenant.
Assistant Dental Surgeon.....	Lieutenant (junior grade).

Dental officers while not promoted above the rank of lieutenant commander may, after serving the prescribed time in the rank, receive the pay and allowances of a commander and captain.

Warrant officers.

Warrant officers in the Navy are of two classes: Commissioned or chief warrant officers, appointed by the President, by and with the advice and con-

sent of the Senate, ranking with, but after, ensign: and warrant officers, appointed by the Secretary of the Navy, and ranking with, but after, midshipman.

There are seven corps of warrant officers, as follows: Boatswains, gunners, and machinists, who belong to the line, and carpenters, sailmakers, pharmacists, and pay clerks, who belong to the staff. After six years' service as such, and after passing satisfactorily such examination as the Secretary of the Navy may prescribe, warrant officers are promoted to the grade of commissioned warrant officers, and are then known as chief boatswains, chief gunners, etc. Commissioned warrant officers with creditable records, after 6 and 12 years' service as such, receive the pay and allowances of the second and third pay periods, respectively. Chief boatswains, chief gunners, or chief machinists, and boatswains, gunners, or machinists are eligible for examination for appointment as ensign and may be appointed as such, not to exceed 12 in any one year. Acting pay clerks, pay clerks, and chief pay clerks are eligible for examination for appointment as assistant paymaster.

Enlisted personnel.

As previously mentioned, all enlisted men enter the Navy for a stated period of service.

The enlisted personnel of the Navy is divided into six branches—seaman, artificer, special, commissary, messman, and aviation. The tabulation below shows the distribution and precedence of ratings by classes, with the abbreviation of each rating as directed to be used by the Bureau of Navigation:

CHIEF PETTY OFFICERS.

SEAMAN BRANCH.

Chief boatswain's mate.....	C. B. M.	Chief quartermaster.....	C. Q. M.
Chief gunner's mate.....	C. G. M.	Chief signalman.....	C. S. M.
Chief turret captain.....	C. T. C.	Chief fire controlman.....	C. F. C.
Chief torpedoman.....	C. T. M.		

ARTIFICER BRANCH.

Chief machinist's mate.....	C. M. M.	Chief carpenter's mate.....	C. C. M.
Chief motor machinist's mate.....	C. Mo. M. M.	Chief shipfitter.....	C. S. F.
Aviation chief machinist's mate.....	A. C. M. M.	Aviation chief carpenter's mate.....	A. C. C. M.
Chief water tender.....	C. W. T.	Aviation chief metalsmith.....	A. C. M.
Chief electrician's mate.....	C. E. M.	Aviation chief rigger.....	A. C. R.
Chief radioman.....	C. R. M.	Chief printer.....	C. Prtr.

SPECIAL BRANCH.

Chief yeoman.....	C. Y.	Chief photographer.....	C. P.
Chief storekeeper.....	C. S. K.	Bandmaster.....	B. Mstr.
Chief commissary steward.....	C. C. Std.	Chief pharmacist's mate.....	C. Ph. M.

PETTY OFFICERS, FIRST CLASS.

SEAMAN BRANCH.

Boatswain's mate, first class.....	B. M. 1c.	Quartermaster, first class.....	Q. M. 1c.
Gunner's mate, first class.....	G. M. 1c.	Signalman, first class.....	S. M. 1c.
Turret captain, first class.....	T. C. 1c.	Fire controlman, first class.....	F. C. 1c.
Torpedoman, first class.....	T. M. 1c.		

ARTIFICER BRANCH.

Machinist's mate, first class.....	M. M. 1c.	Blacksmith, first class.....	Bsmth. 1c.
Motor machinist's mate, first class.....	Mo. M. M. 1c.	Boilermaker, first class.....	Bmkr. 1c.
Aviation machinist's mate, first class.....	A. M. M. 1c.	Molder, first class.....	Mldr. 1c.
Engineman, first class.....	Eng. 1c.	Patternmaker, first class.....	Pmkr. 1c.
Water tender, first class.....	W. T. 1c.	Aviation carpenter's mate, first class.....	A. C. M. 1c.
Electrician's mate, first class.....	E. M. 1c.	Aviation metalsmith, first class.....	A. M. 1c.
Radioman, first class.....	R. M. 1c.	Aviation rigger, first class.....	A. R. 1c.
Carpenter's mate, first class.....	C. M. 1c.	Printer, first class.....	Prtr. 1c.
Shipfitter, first class.....	S. F. 1c.	Painter, first class.....	Ptr. 1c.
Coppersmith, first class.....	Csmth. 1c.	Sailmaker's mate, first class.....	S. M. M. 1c.

SPECIAL BRANCH.

Yeoman, first class.....	Y. 1c.	First musician.....	1st. Mus.
Storekeeper, first class.....	S. K. 1c.	Ship's cook, first class.....	S. C. 1c.
Commissary steward.....	C. Std.	Baker, first class.....	Bkr. 1c.
Photographer, first class.....	P. 1c.	Pharmacist's mate, first class.....	Ph. M. 1c

PETTY OFFICERS, SECOND CLASS.

SEAMAN BRANCH.

Boatswain's mate, second class....	B. M. 2c.	Quartermaster, second class.....	Q. M. 2c.
Gunner's mate, second class.....	G. M. 2c.	Signalman, second class.....	S. M. 2c.
Torpedoman, second class.....	T. M. 2c.		

ARTIFICER BRANCH.

Machinist's mate, second class....	M. M. 2c.	Blacksmith, second class.....	Bsmth. 2c.
Motor machinist's mate, second class.....	Mo. M. M. 2c.	Boilermaker, second class.....	Bmkr. 2c.
Aviation machinist's mate, second class.....	A. M. M. 2c.	Molder, second class.....	Mldr. 2c.
Engineman, second class.....	Eng. 2c.	Patternmaker, second class.....	Pmkr. 2c.
Water tender, second class.....	W. T. 2c.	Aviation carpenter's mate, second class.....	A. C. M. 2c.
Electrician's mate, second class.....	E. M. 2c.	Aviation metalsmith, second class.....	A. M. 2c.
Radioman, second class.....	R. M. 2c.	Aviation rigger, second class.....	A. R. 2c.
Carpenter's mate, second class.....	C. M. 2c.	Printer, second class.....	Prtr. 2c.
Shipfitter, second class.....	S. F. 2c.	Painter, second class.....	Ptr. 2c.
Coppersmith, second class.....	Csmth. 2c.	Sailmaker's mate, second class.....	S. M. M. 2c.

SPECIAL BRANCH.

Yeoman, second class.....	Y. 2c.	Ship's cook, second class.....	S. C. 2c.
Storekeeper, second class.....	S. K. 2c.	Baker, second class.....	Bkr. 2c.
Photographer, second class.....	P. 2c.	Pharmacist's mate, second class....	Ph. M. 2c.

PETTY OFFICERS, THIRD CLASS.

SEAMAN BRANCH.

Coxswain.....	Cox.	Quartermaster, third class.....	Q. M. 3c.
Gunner's mate, third class.....	G. M. 3c.	Signalman, third class.....	S. M. 3c.
Torpedoman, third class.....	T. M. 3c.		

ARTIFICER BRANCH.

Electrician's mate, third class.....	E. M. 3c.	Aviation metalsmith, third class....	A. M. 3c.
Radioman, third class.....	R. M. 3c.	Aviation rigger, third class.....	A. R. 3c.
Carpenter's mate, third class.....	C. M. 3c.	Printer, third class.....	Prtr. 3c.
Shipfitter, third class.....	S. F. 3c.	Painter, third class.....	Ptr. 3c.
Aviation carpenter's mate, third class.....	A. C. M. 3c.	Sailmaker's mate, third class.....	S. M. M. 3c.

SPECIAL BRANCH.

Yeoman, third class.....	Y. 3c.	Ship's cook, third class.....	S. C. 3c.
Storekeeper, third class.....	S. K. 3c.	Baker, third class.....	Bkr. 3c.
Photographer, third class.....	P. 3c.	Pharmacist's mate, third class....	Ph. M. 3c.

NONRATED MEN, FIRST CLASS.

SEAMAN BRANCH.

Seaman, first class.....			Sea. 1c
--------------------------	--	--	---------

ARTIFICER BRANCH.

Fireman, first class.....			F. 1c.
---------------------------	--	--	--------

SPECIAL BRANCH.

Bugler, first class.....	Bug. 1c.	Musician, first class.....	Mus. 1c.
Hospital apprentice, first class.....			H. A. 1c.

NONRATED MEN, SECOND CLASS.

SEAMAN BRANCH.

Seaman, second class.....			Sea. 2c.
---------------------------	--	--	----------

ARTIFICER BRANCH.

Fireman, second class.....			F. 2c.
----------------------------	--	--	--------

SPECIAL BRANCH.

Bugler, second class.....	Bug. 2c.	Musician, second class.....	Mus. 2c.
Hospital apprentice, second class.....			H. A. 2c.

NONRATED MEN, THIRD CLASS.

SEAMAN BRANCH.

Apprentice seaman.....	A. S.
------------------------	-------

ARTIFICER BRANCH.

Fireman, third class.....	F. 3c.
---------------------------	--------

MESSMAN BRANCH.

Cabin steward.....	Cab. Std.	Warrant officer's steward.....	W. O. Std.
Cabin cook.....	Cab. Ck.	Warrant officer's cook.....	W. O. Ck.
Wardroom steward.....	W. R. Std.	Mess attendant, first class.....	M. Att. 1c.
Wardroom cook.....	W. R. Ck.	Mess attendant, second class.....	M. Att. 2c.
Steerage steward.....	Stg. Std.	Mess attendant, third class.....	M. Att. 3c.
Steerage cook.....	Stg. Ck.		

The titles of the Marine Corps enlisted personnel as abbreviated by the Medical Department are as follows:

Sergeant (all grades).....	Sgt.	Apprentice Marine.....	App.
Corporal.....	Corp.	Drummer.....	Drum.
Private.....	Pvt.	Trumpeter.....	Tpt.

The ranks of officers, the several staff corps and the titles of members of the Nurse Corps (female) are abbreviated by the Medical Department as follows:

Admiral.....	Adm.	Chief Sailmaker.....	ChSlmkr.
Vice Admiral.....	VAdm.	Sailmaker.....	Slmkr.
Rear Admiral.....	RAdm.	Chief Pharmacist.....	ChPharm.
Captain (U. S. N.).....	Capt.	Pharmacist.....	Pharm.
Commander.....	Comdr.	Chief Pay Clerk.....	ChPayClk.
Lieutenant Commander.....	Lt-Comdr.	Pay Clerk.....	PayClk.
Lieutenant.....	Lt.	Acting Pay Clerk.....	ActPayClk.
Lieutenant (junior grade).....	Lt-jg.	Major general (U. S. M. C.).....	MajGM.
Ensign.....	Ens.	Brigadier general (U. S. M. C.).....	BrGM.
Midshipman.....	Mid-1c, etc.	Colonel (U. S. M. C.).....	ColM.
Chief Boatswain.....	ChBtsn.	Lieutenant colonel (U. S. M. C.).....	LtCM.
Boatswain.....	Btsn.	Major (U. S. M. C.).....	MajM.
Chief Gunner.....	ChGun.	Captain (U. S. M. C.).....	CaptM.
Gunner.....	Gun.	First lieutenant (U. S. M. C.).....	1-Lt.
Chief Machinist.....	ChMach.	Second lieutenant (U. S. M. C.).....	2-Lt.
Machinist.....	Mach.	Marine gunner (U. S. M. C.).....	Mar. Gun.
Chief Carpenter.....	ChCarp.	Quartermaster clerk (U. S. M. C.).....	QMClk.
Carpenter.....	Carp.	Pay clerk (U. S. M. C.).....	PayClkM.

STAFF CORPS.

(The abbreviations, in parentheses, immediately follow the abbreviation of the rank.)

Medical Corps.....	(MC).	Civil Engineer Corps.....	(CEC).
Medical Corps (dental surgeons)...	(MCDS).	Professors of Mathematics.....	(Math).
Supply Corps.....	(SC).	Retired.....	(Ret).
Chaplain Corps.....	(ChC).	Coast Guard Service.....	(CGS).
Construction Corps.....	(CC).	Lighthouse Service.....	(LHS).
Public Health Service.....	(PHS).		

NURSE CORPS (F.).

Superintendent.....	Supt.	Nurse.....	Nurse.
Chief Nurse.....	Ch. Nurse.		

THE FLEET AND THE NAVAL STATIONS FOR ITS UPKEEP.

Primarily, the Navy is the fleet, composed of the combatant ships and their auxiliaries.

The vessels of the fleet comprise battleships, cruisers and light cruisers, aircraft carriers, mine layers, mine sweepers, destroyers, submarines, patrol vessels (gunboats, etc.), destroyer, submarine and aircraft tenders, repair

ships, store ships, colliers, oilers, ammunition and cargo ships, transports, hospital ships, and fleet tugs.

The principal naval force is the United States Fleet, and those forces not assigned to the United States Fleet are organized as separate commands as follows:

Asiatic Fleet.

Naval Forces, Europe.

Special Service Squadron.

Submarine Divisions, Atlantic.

Submarine Divisions, Pacific.

Naval District Forces.

The United States Fleet is composed of the following fleets and forces: (1) Battle Fleet, (2) Scouting Fleet, (3) Control Force, and (4) Fleet Base Force, each of which consists of units of vessels of different types.

Although afloat, the fleet and its auxiliaries must place great dependence on shore stations for many repairs, for supplies and equipment, and for personnel so that the maximum of efficiency may be maintained. As a direct result of this dependence of the fleet, the Navy Department has under its control a number of naval stations both within and without the continental limits of the United States. The most important are enumerated below.

Navy yards or naval stations.

Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; Philadelphia, Pa.; Washington, D. C.; Norfolk, Va.; Charleston, S. C.; Mare Island, Calif.; Puget Sound, Wash.; Pearl Harbor, T. H.; Samoa, Guam, Cavite, and Olongapo, P. I.; Virgin Islands of United States; Guantanamo Bay, Cuba.

Naval operating bases.

Hampton Roads, Va.; Key West, Fla.; San Diego, Calif.; San Francisco, Calif.; Canal Zone; Pearl Harbor, T. H.

Naval training stations.

Newport, R. I.; Hampton Roads, Va.; Great Lakes, Ill.; San Diego, Calif.

Submarine bases.

New London, Conn.; Hampton Roads, Va.

Naval torpedo stations.

Newport, R. I.; Alexandria, Va.; Keyport, Wash.

Naval proving ground.

Dahlgren, Va.

Naval powder factory.

Indianhead, Md.

Naval mine depot.

Yorktown, Va.

Ammunition depots.

Hingham, Mass.; Iona Island, N. Y.; Dover, N. J.; Fort Mifflin, Pa.; St. Juliens Creek, Va.; Mare Island, Calif.; Puget Sound, Wash.

In addition to the stations enumerated above, the following activities are controlled by the Navy Department:

Naval Academy, Annapolis, Md.

Naval Gun Factory, Washington, D. C.

Naval Experimental and Research Laboratory, Bellevue, D. C.

Naval Ordnance Plants, Baldwin, Long Island; and South Charleston, W. Va.

Naval Supply Depot, South Brooklyn, N. Y.

The following definitions from United States Navy Regulations clearly state the composition and object of shore stations, strategy, tactics, and naval policy:

"A naval base is, generically, a center from which men-of-war can operate and be maintained, and may be of a permanent or temporary character, depending upon whether its constructed naval accommodations are of a fixed or transient nature." (Art. 2050 (a), N. R.)

"Naval bases are divided geographically into two classes, home bases and outlying bases, and these are themselves divided by their facilities into main bases, subsidiary bases, and bases for particular types of naval craft. (Destroyer bases, submarine bases, aviation bases, etc.)." (Art. 2050 (b), N. R.)

"A main base is one within the continental territory of the country, from which the fleet can operate at all times and which is designed to maintain the fleet in all respects, both in peace and war." (Art. 2050 (c), N. R.)

"A main outlying base is one without the continental limits of the country, having as many of the attributes of a main home base as practicable, and designed to be a strong point of support for the fleet and from which it can be maintained for limited periods in war." (Art. 2050 (d), N. R.)

"A subsidiary base (home or outlying) is one that contains some of the fixed elements of a main base and which, while not capable of supporting and maintaining the whole fleet, may so care for portions of it." (Art. 2050 (e), N. R.)

"A destroyer, submarine, aviation, or other base for particular types of naval craft is one from which the type in question can operate and be maintained. It may or may not form part of a main or subsidiary base." (Art. 2050 (f), N. R.)

"An outlying base of a temporary character used in war for the fleet or portions of it is termed as advanced base." (Art. 2050 (g), N. R.)

"The characters, composition, and strength of naval bases will depend upon the necessities of service, at all times." (Art. 2050 (h), N. R.)

"A naval station is the location of a particular form of naval activity, and may or may not form part of a naval base." (Art. 2050 (i), N. R.)

"A naval depot is the location where naval personnel or matériel is stored and delivered, and may or may not form a part of a naval base." (Art. 2050 (j), N. R.)

"Strategy applies to the distribution of naval forces, their armament and supplies in preparation for war or in the prosecution of war. It includes logistics. It refers to naval movements and dispositions made before contact with enemy's forces." (Art. 2051, N. R.)

"Tactics applies to all naval movements and operations made after contact with the enemy's forces. The term 'contact' is here employed in a broad sense, meaning such proximity to the enemy as affects fleet formation and renders a battle imminent." (Art. 2052, N. R.)

"*Naval policy*.—Everything that includes the fixed condition of preparation for war; that is, the strength, character, and composition of the Navy, fortification of ports and bases, etc. (This will be based upon our political relations and the probability of war with different powers. It will also be influenced by the conclusions of a comprehensive study of the political relations between other powers throughout the world and their influence upon coalitions and allowances.)" (Art. 2053, N. R.)

THE UNITED STATES MARINE CORPS.

The United States Marine Corps is a military branch of the Navy under control of the Secretary of the Navy, and is subject to the laws and regulations for

the government of the Navy. The United States Marine Corps may, by order of the President of the United States, be detached for service with the United States Army, when it becomes subject to the rules and articles of war prescribed for the government of the Army.

The headquarters of the United States Marine Corps is in Washington, D. C. The head of the Marine Corps is designated as the major general commandant of the Marine Corps, has the rank of major general, and is appointed from officers in the Marine Corps by the President, by and with the advice and consent of the Senate, for four years.

The commandant of the Marine Corps is responsible to the Secretary of the Navy for the general efficiency and discipline of the corps. He makes such distribution of officers and men for duty in the several shore stations as appear to him to be most advisable for the interests of the service; furnishes detachments for vessels of the Navy, according to the authorized scale of allowance; under the direction of the Secretary of the Navy issues orders for the movements of officers and troops and such other orders and instructions for their guidance as may be necessary, and has charge and exercises general supervision and control of the recruiting service of the corps and of the necessary expenses thereof, including the establishment of recruiting stations.

The duties of the United States Marine Corps are defined by an Executive order of November 12, 1908, as follows: "To garrison the different navy yards and naval stations, both within and beyond the continental limits of the United States.

"To furnish the first line of mobile defense of naval bases and naval stations beyond the continental limits of the United States.

"To man such naval stations and to aid in manning, if necessary, such other defenses as may be erected for the defense of naval bases and naval stations beyond the continental limits of the United States.

"To garrison the Isthmian Canal Zone, Panama.²

"To furnish such garrisons and expeditionary forces for duties beyond the seas as may be necessary in time of peace."

THE BUREAU OF MEDICINE AND SURGERY.

From before the inception of our Government to August 31, 1842, the history of the medical department of the Navy is interwoven with that of other branches of the service.

In 1775 the Continental Congress organized the Navy. Thus it will be seen that our Navy has existed longer than the Government and was established prior to the Declaration of Independence. Military control of the earliest vessels of the Navy was directly under the Continental Congress and was conducted through its naval committee.

Under our present form of government the executive department known as the Department of War was created by act of Congress in 1789. This department controlled the Navy as well as the Army. By the act of Congress of April 30, 1798, another executive department, denominated the Department of the Navy, was established. But the Navy Department was not divided into bureaus, consisting only of one office, whose head then, as now, was the Secretary of the Navy.

² The marine battalion stationed in the Canal Zone was withdrawn May 1, 1914, and has not been replaced.

Each vessel of the Navy in these historical days carried at least one surgeon, and some of the larger ships a surgeon and surgeon's mate. Surgeons usually held commissions, and the surgeon's mates received warrants. These members of the medical profession serving in the Navy seem to have had little, if any, relationship to one another (which is not to be wondered at when one realizes that at that time there was no medical corps and no organization in the Navy Department directly responsible for the supervision of them or their work), and their rank and status was not well defined.

The first attempt to regulate the medical establishment and provide a systematic organization occurred in 1799, when Congress authorized the following officers in the medical establishment of the United States: "A physician general who shall be charged with the superintendence and direction of all military hospitals, and generally of all medical and chirurgical practice or service concerning the Army or Navy of the United States, and of all persons who shall be employed in and about the same, in camps, garrisons, and hospitals; an apothecary general, and one or more deputies, who shall be charged with the safe-keeping and delivery of all medicines, instruments, dressings, and other articles for the use of the hospital and Army; a purveyor, who shall be charged with providing medicines, stores, and whatsoever else may be necessary in relation to said practice or service."

In 1815 Congress authorized the President to appoint three naval officers as a board of commissioners for the Navy, to be attached to the Secretary's office and, under his direction, to discharge the ministerial duties of his office. Here may be seen the first step toward the creation of the present day chiefs of bureaus. In 1832 two post captains were added to the board of commissioners for the Navy, making five members on the committee.

Then came the reorganization of the Navy Department, when by the act of August 31, 1842, the board of commissioners for the Navy was abolished and five bureaus were created to conduct the business of the Navy Department.

The Secretary of the Navy by this act was directed to assign the duties of the newly created bureaus in the following words: "Sec. 5. And be it further enacted, That the Secretary of the Navy shall assign and distribute among the said bureaus such of the duties of the Navy Department as he shall judge to be expedient and proper; and all the duties of the said bureaus shall be performed under the authority of the Secretary of the Navy, and their orders shall be considered as emanating from him and shall have full force and effect as such."

One of the bureaus created by this act, and by it responsible for conducting a part of the business of the Navy Department, was the Bureau of Medicine and Surgery, and its existence as a separate and distinct bureau in the Navy Department dates from August 31, 1842.

At that time there were 60 surgeons in the Navy and the first chief of the Bureau of Medicine and Surgery was selected from them. Upon the man so selected rested the burden of planning the organization of the newly created bureau, of developing a medical corps, of coordinating the activities of the surgeons and surgeon's mates, and other personnel, and formulating the necessary regulations to govern and control this branch of the Navy Department.

Viewed from the standpoint of later years it must be conceded that a wise selection was made in choosing as the first Chief of the Bureau of Medicine and Surgery, Surg. William Paul Crillon Barton. By education, training, and naval experience he was peculiarly fitted to organize and administer the new bureau, and to him must be accorded full credit for the work which he performed under adverse and trying conditions in establishing the bureau upon a firm foundation.

Following is a list of the names of the chiefs of the Bureau of Medicine and Surgery and the Surgeons General, United States Navy, from 1842 to date.

Chief of Bureau. (Act of August 31, 1842.)

William Paul Crillon Barton.....	Sept. 2, 1842, to Apr. 1, 1844.
Thomas Harris.....	Apr. 1, 1844, to Sept. 30, 1853.
William Whelan.....	Oct. 1, 1853, to June 11, 1865.
Phineas J. Horwitz.....	July 1, 1865, to June 30, 1869.

Chief of Bureau, with relative rank and pay of commodore and title of Surgeon General. (Act of March 3, 1871.)

William Maxwell Wood.....	July 1, 1869, to Oct. 31, 1871.
Jonathan M. Foltz.....	Nov. 1, 1871, to June 8, 1872.
James C. Palmer.....	June 10, 1872, to July 8, 1873.
Joseph Beale.....	July 9, 1873, to Feb. 2, 1877.
William Grier.....	Feb. 3, 1877, to Oct. 5, 1878.
J. Winthrop Taylor.....	Oct. 28, 1878, to Aug. 19, 1879.
Philip S. Wales.....	Aug. 20, 1879, to Jan. 27, 1884.
Francis M. Gunnell.....	Apr. 1, 1884, to Apr. 1, 1888.
John Mills Browne.....	Apr. 2, 1888, to May 10, 1893.
James Rufus Tryon.....	May 11, 1893, to Sept. 7, 1897.
Newton L. Bates.....	Oct. 1, 1897, to Oct. 18, 1897.

Chief of Bureau, with the rank of rear admiral, title of Surgeon General, and pay and allowances of brigadier general in the Army. (Act of March 3, 1899.)

William Knickerbocker Van Reypen.....	Oct. 23, 1897, to Jan. 25, 1902.
Presley Marion Rixey.....	Feb. 5, 1902, to Feb. 4, 1910.
Charles Francis Stokes.....	Feb. 7, 1910, to Feb. 6, 1914.

Chief of Bureau, with the rank of rear admiral, title of Surgeon General, and pay and allowances of major general in the Army. (Act of July 1, 1918.)

William Clarence Braisted.....	Feb. 7, 1914, to Nov. 29, 1920.
Edward Rhodes Stitt.....	Nov. 30, 1920 (present incumbent).

The duties of the Bureau of Medicine and Surgery as defined by the United States Navy Regulations, articles 457 and 458, are given on pages 588 and 589.

To carry out these duties, officers and enlisted men of the Medical Department of the Navy necessarily will be found wherever the activities of the Navy lead.

The primary duty of the medical department of the Navy is to preserve the Navy's personnel from impairment by reason of sickness or injury, and to return men so incapacitated to active duty in the shortest period consistent with circumstances. To accomplish this object more readily, naval hospitals have been established at the geographical points where concentration of naval activities occurs and the Bureau of Medicine and Surgery is charged with their upkeep and operation under the general charge and superintendence of the Secretary of the Navy. Officers and enlisted men of the Navy and Marine Corps, afloat or ashore, in need of hospital treatment are transferred to the naval hospital most convenient to the ship or station on which they are serving at the time. To provide hospital care for the personnel of the fleets when transfer to a naval hospital is not possible, modern hospital ships are available.

It is in naval hospitals that the medical department's utility as a conserving force of the personnel of the Navy becomes most apparent, where its sphere of usefulness is best demonstrated, and where all that pertains to the sick and injured finds its fullest development.

The naval hospitals controlled by the Bureau of Medicine and Surgery and at present in commission are located at: Portsmouth, N. H.; Chelsea, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va.; Parris Island, S. C.; Charleston, S. C.; Key West, Fla.; Pensacola, Fla.; Great Lakes, Ill.; San Diego, Calif.; Mare Island, Calif.; Puget Sound, Wash.; Pearl Harbor, Hawaii; Guam; Canacao, P. I. and Yokohama, Japan. The naval hospital at New Orleans, La., is not in commission. In addition to the above naval hospitals, at the submarine base at New London, Conn., and at the Marine Barracks, Quantico, Va., establishments commonly known as sick quarters provide for the care of the sick and injured at these places in a manner similar to naval hospitals.

In addition to the hospitals directly under the cognizance of the Bureau of Medicine and Surgery there are special hospitals at which Navy and Marine Corps patients may receive treatment. One is the Army and Navy General Hospital at Hot Springs, Ark., where relief reasonably may be expected for rheumatic conditions after the acute or inflammatory stages, conditions resulting from gout, rheumatism, or metallic or malarial poisoning, chronic skin diseases, certain functional diseases, and some other diseases. In the Fitzsimons General Hospital, United States Army, at Denver, Colo., cases of pulmonary tuberculosis may receive treatment. Insane cases are cared for at St. Elizabeths Hospital, Washington, D. C. (formerly known as the Government Hospital for the Insane), and at the State hospitals for insane persons at Mendocino and Napa, Calif. Patients at these latter institutions may be transferred to St. Elizabeths Hospital. At Philadelphia, Pa., "a permanent asylum for disabled and decrepit Navy officers, seamen, and marines" has been established and is known as the United States Naval Home. Here persons who have served 20 years in the Navy or Marine Corps and are disabled from earning their living by manual labor, who have served nearly that length of time with creditable records and been discharged for disability, or who have served a number of years with an exceedingly meritorious record and have been disabled in the line of duty, may be admitted upon authority of the Secretary of the Navy.

When naval hospitals are not convenient, the hospitals and contract stations of the United States Public Health Service are available for the treatment of the Navy's sick, and in emergency patients may be transferred to a civil hospital, as provided for in article 1143, United States Navy Regulations.

THE SOURCE AND DISBURSEMENT OF MONIES PERTAINING TO THE BUREAU OF MEDICINE AND SURGERY.

Annual appropriations.

Congress annually appropriates money for the expenses of the Navy, and this money is placed under the cognizance of the bureaus concerned for economical expenditure. One of the most important duties devolving upon the administrative head of the Bureau of Medicine and Surgery is the application to the proper purposes of the monies under its control. This most important duty is performed through the finance division of the Bureau of Medicine and Surgery.

By means of the monies, services, supplies, medicines, instruments, etc., are procured for the medical department of the Navy on ships, stations, and at hospitals. As such supplies and services may be obtained only by means of requisitions and vouchers it is very important that hospital corpsmen whose duty it becomes to prepare requisitions and vouchers for supplies, etc., have a clear comprehension of the source and applicability of monies under cognizance of the bureau.

While the Bureau of Medicine and Surgery has control over certain monies to defray necessary expenses incident to the various duties with which it is charged, it should be understood distinctly that the actual disbursement is not made by any officer connected with that bureau. This, as does the disbursement of all money expended for the Navy, devolves upon disbursing officers of the Supply Corps under the Bureau of Supplies and Accounts, and in some few instances upon the general accounting officers of the Treasury Department.

Monies controlled by the Bureau of Medicine and Surgery are received from two general sources, i. e., annual appropriations made by Congress and the Naval Hospital Fund.

Annual appropriations are made by Congress for the expenses during the fiscal year for which made. These appropriations are based upon careful estimates prepared by the several bureaus for the Secretary of the Navy, and transmitted by him to the Director of the Budget who submits them to Congress through the President of the United States.

The annual appropriations included in the naval appropriation bill that pertain to the Bureau of Medicine and Surgery are classified under the following fixed titles:

- (a) Medical department.
- (b) Contingent, Bureau of Medicine and Surgery.
- (c) Bringing home remains of officers, and so forth.
- (d) Care of hospital patients.
- (e) Salaries, Navy Department.

The detailed object of expenditures under the fixed titles can be found in each annual digest of appropriations. The full phraseology of the several bureau appropriations for the fiscal year 1924 immediately follow. The exact wording may be changed from year to year to meet exigencies of the service.

(a) "Medical Department. For surgeon's necessities for vessels in commission, navy yards, naval stations, and Marine Corps; and for the civil establishment at the several naval hospitals, navy yards, naval medical supply depots Naval Medical School and Dispensary, Washington, and Naval Academy, \$1,760,000; *Provided*, That the sum to be paid out of this appropriation, under the direction of the Secretary of the Navy, for clerical service in naval hospitals, dispensaries, medical supply depots, and Naval Medical School, for the fiscal year ending June 30, 1924, shall not exceed \$150,000.

(b) "Contingent, Bureau of Medicine and Surgery. For tolls and ferriages; care, transportation, and burial of the dead, including officers who die within the United States, and supernumerary patients who die in naval hospitals; purchase of cemetery lots; purchase of books and stationery, binding of medical records, unbound books, and pamphlets; hygienic and sanitary investigation and illustration; sanitary, hygienic, and special instruction, including the printing and issuing of naval medical bulletins and supplements; purchase and repairs of nonpassenger-carrying wagons, automobile ambulances, and harness; purchase of and feed for horses and cows; maintenance, repair, and operation of two passenger-carrying motor vehicles for naval dispensary, Washington.

District of Columbia, and one motor-propelled vehicle for official use only for the medical officer on out-patient medical service at the Naval Academy; trees, plants, care of grounds, garden tools, and seeds; incidental articles for the Naval Medical School and naval dispensary, Washington, naval medical supply depots, sick quarters at Naval Academy and marine barracks; washing for medical department at Naval Medical School and naval dispensary, Washington, naval medical supply depots, sick quarters at Naval Academy and marine barracks, dispensaries at navy yards and naval stations, and ships; and for minor repairs on buildings and grounds of the United States Naval Medical School and naval medical supply depots; rent of rooms for naval dispensary, Washington, District of Columbia, not to exceed \$1,200; for the care, maintenance, and treatment of the insane of the Navy and Marine Corps on the Pacific coast, including supernumeraries held for transfer to the Government Hospital for the Insane; for dental outfits and dental material, and all other necessary contingent expenses; **in all, \$365,000.**

(c) "Bringing home remains of officers, and so forth. To enable the Secretary of the Navy, in his discretion, to cause to be transferred to their homes the remains of officers and enlisted men of the Navy and Marine Corps, of members of the Nurse Corps, of civilian officers and crews of naval auxiliaries, and of officers and enlisted men of the Naval Militia and National Naval Volunteers and the Naval Reserve Force when on active service with the Navy, who die or are killed in action ashore or afloat, and also to enable the Secretary of the Navy, in his discretion, to cause to be transported to their homes the remains of civilian employees who die outside of the continental limits of the United States, \$40,000: *Provided*, That the sum herein appropriated shall be available for payment for transportation of the remains of officers and men who have died while on duty at any time since April 21, 1898.

(d) "Care of hospital patients. For the care, maintenance, and treatment of patients, including supernumeraries, in naval and other than naval hospitals, \$100,000.

(e) "Salaries, Navy Department. For employees in the Bureau of Medicine and Surgery, \$60,000: *Provided*, That no person shall be employed hereunder at a rate of compensation exceeding \$1,800 per annum, except the following: One (chief clerk), \$2,250, and two at \$2,000 each."

Naval hospital fund.³

The Naval Hospital Fund dates its separate existence as such from an act of Congress approved February 26, 1811. In this same law Congress provided for the establishment of naval hospitals and directed that \$50,000 be appropriated out of the unexpended balance of the Marine Hospital Fund (created on July 16, 1798) for the purpose of a Naval Hospital Fund. It originally was controlled by the "Commissioners of Navy Hospitals," a board composed of the Secretaries of the Navy, the Treasury, and War, but by the act of July 10, 1832, Congress made the Secretary of the Navy the sole trustee of this fund.

The monies of this fund are deposited in the United States Treasury and expenditures from it are safeguarded by the same laws, regulations, and procedures as govern the expenditures of appropriations belonging to the United States Government.

³ For a complete description of the Naval Hospital Fund, refer to Chapter 21, Manual of the Medical Department, 1922.

The several sources of revenue of the Naval Hospital Fund are:

(a) Twenty (20) cents per month "hospital tax" deducted from the pay of each officer, seaman, and marine, including members of the Nurse Corps and Naval Auxiliary Service. (Sec. 4808, R. S.)

(b) The value of one ration per day during the period that each patient remains in a naval hospital. (Sec. 4812, R. S.)

(c) The pensions of naval patients and supernumeraries while under treatment in naval hospitals. (Sec. 4813, R. S.)

(d) The balance of all fines imposed by sentence of court-martial after payment for transportation of discharged prisoners to their homes has been made. (Sec. 4809, R. S., and act of March 3, 1909.)

(e) All forfeitures on account of desertions. (Act approved June 7, 1900.)

(f) The value of one ration per day for each member of the personnel subsisted in a naval hospital.

(g) The proceeds from sales of naval hospital property.

(h) Payments made for the care of navy yard employees while in naval hospitals as patients of the Employees Compensation Commission.

Except as Congress provides for certain expenses by specific appropriation, as for the pay of civil employees under "Medical Department," and the care, transportation, and burial of the dead under "Contingent," every expense for the proper establishment and maintenance of a naval hospital may be paid from the Naval Hospital Fund.

Appropriation numbers.

Numbers for the separate appropriations under the cognizance of each bureau are assigned by the Bureau of Supplies and Accounts. The first figure of an appropriation number indicates the fiscal year, the second the bureau, and the third and fourth the specific appropriation. Thus, reading from right to left, the number 3801 indicates the appropriation, medical department, controlled by the Bureau of Medicine and Surgery, for the fiscal year 1923, while the number 3815 indicates the Naval Hospital Fund, controlled by the Bureau of Medicine and Surgery, for the fiscal year 1923.

ORGANIZATION OF THE BUREAU OF MEDICINE AND SURGERY.

The outline given herewith shows the present organization of the Bureau of Medicine and Surgery for the conduct of the necessary business entrusted to its care. The reciprocal relations of this bureau with the other bureaus of the Navy Department are evident after study of the duties of those bureaus as heretofore described.

The Surgeon General of the Navy is the Chief of the Bureau of Medicine and Surgery and its administrative head. Upon him devolves the formulation of general policies and the maintenance of contact with:

(a) The medical divisions of the fleets through the fleet surgeons.

(b) The medical departments of naval stations through the senior medical officers.

(c) Naval hospitals, naval medical supply depots, naval Medical and Hospital Corps training schools, and separate naval dispensaries or sick quarters through their commanding or senior medical officers.

The assistant to the bureau acts as the executive, has general supervision of the entire organization and work of the bureau, assists in the development of general policies, and in the absence of the Surgeon General becomes the acting chief of the bureau and signs all mail or official correspondence.

The chief clerk has general supervision of the operation of the various bureau offices and becomes the acting chief of the bureau in the absence of both the chief of bureau and assistant to bureau.

For ease of administration and to facilitate the transactions of business, the bureau is divided into divisions and sections. The present divisions of the bureau, the division chiefs, and section heads, and the work for which each is responsible is shown in the tabulation below.

Division of administration.—Chief of Division: Chief Clerk.

(a) Public works section.—Head of section: Chief of division.

1. General cognizance of and cooperation with Bureau of Yards and Docks concerning all construction authorized or proposed.

(b) Mail, general files and correspondence section.—Head of section: Chief of division.

1. All general correspondence; reference to previous correspondence; storage of old files and records; files of blueprints of ships and station buildings; card indices arranged under station, subject, name of person, and in chronological order; receipt, distribution and forwarding of all mail.

(c) Office supplies and printing section.—Head of section: Civilian clerk.

1. Requisitions for and issue of office supplies and equipment; printing and binding of medical department bulletins, supplements, forms, medical records, etc.; printing or multigraphing of circular letters, special reports, etc.

(d) Civil personnel and care of the dead section.—Head of section: Civilian clerk.

1. Assignments of stenographers, clerks, and messengers; personal data; efficiency records; time sheets; annual leave; sick leave, etc.; appointments at hospitals, sick quarters, supply depots, dispensaries, and medical school; Civil Service matters; retirements; wage scale; reclassification; complements; correspondence relating to civil establishment.

2. Notices of death of personnel; correspondence with next of kin; shipment of remains; funeral arrangements; burial records.

Division of finances.—Chief of division: Chief pharmacist, U. S. Navy.

(a) Budget section.—Head of section: Chief of division.

1. Preparation of estimates; administration of appropriations and Naval Hospital Fund; allocation of funds to hospitals, ships and stations; laws, regulations, and instructions governing the submission of estimates, expenditure, and receipt of money, and Budget circulars; under the direction of the Chief of Bureau, arranges the allotment or apportionment of funds, whether made by time or object; information as to current status of obligations, allotments and apportionments.

(b) Accounting section.—Head of section: Pharmacist, U. S. Navy.

1. Preparation and filing of allotments; examination and filing of reports of expenditures; general ledgers and day books; preparation of financial data; accounting procedures; receipts and credits; obligations incurred or authorized; balances available for future obligation; charges made against appropriations; monthly check of charges and their correctness, against authorizations and obligations.

(c) Auditing and claims section.—Head of section: Civilian clerk.

1. Adjustment of claims for medical expenses, hospital care, etc.; preparation of vouchers and public bills in payment of claims; reimbursement of appropriations for expenses incurred on account of other Government departments; transfer of funds.

(d) Requisition section.—Head of section: Pharmacist, U. S. Navy.

1. Receipt and action on all requisitions for supplies and services; transfer of matériel between Medical Department activities; surveys on Medical Department property; record of nonexpendable property at Medical Department activities; recording and filing of requisitions, public bills, property surveys, and inventories of property, correspondence relative to above.

Division of personnel.—Chief of division: Commander, M. C., U. S. Navy.

(a) Medical Corps section.—Head of section: Chief of division.

1. Complements; appointments; enrollments, assignments; standards for examinations; examining boards; instruction; promotions; resignations.

(b) Hospital Corps section.—Head of section: Lieutenant, M. C., U. S. Navy. Assistants: Chief Pharmacist, U. S. Navy; Pharmacist, U. S. Navy.

1. Chief pharmacists and pharmacists: Complements; appointments; enrollments; assignments; standards for examinations; examining boards; instruction; promotions; resignations.
2. Enlisted personnel: Complements; enlistments; enrollments; discharges; transfers; advancements and changes in rating; standards for examinations; standards for instruction; professional competency.
3. Editing and publishing of: Hospital Corps Quarterly; Hospital Corps Handbook; Drill Book for the Hospital Corps.

(c) Nurse Corps section.—Head of section: Superintendent, Nurse Corps, U. S. Navy. Assistants: Two chief nurses, U. S. Navy.

1. Complements; appointments; enrollments; assignments; examinations and requirements; promotions; discharges; resignations; transfers.

Division of rehabilitation and morale. Chief of division: Lieutenant Commander, M. C., U. S. Navy.

(a) Occupational therapy section.—Head of section: Chief of division.

1. Occupational therapy in naval hospitals for United States Veterans' Bureau patients.

(b) Liaison section.—Head of section: Chief of division.

1. Maintains liaison with American Red Cross, United States Veterans' Bureau, morale division of Bureau of Navigation.

Division of instruction and publications.—Chief of division: Commander, M. C., U. S. Navy.

(a) Instruction section.—Head of section: Chief of division.

1. Maintains liaison with: Naval Medical School, School of Dental Medicine; School of Aviation Medicine; School of Field Operations with Marines.
2. In charge of: Regular and special courses; instruction at Army, Navy, and civilian institutions other than above.

(b) War plans and research section.—Head of section: Chief of division. Assistant: Lieutenant, M. C., U. S. Navy.

1. Collection and dissemination of information regarding advances and researches in scientific matters.
2. In charge of matters dealing with and researches in aviation, chemical warfare, submarines and submarine diving.
3. War plans of Medical Department.

(c) Publications section.—Head of section: Lieut. Commander, M. C., U. S. Navy.

1. Editing and publishing of: Naval Medical Bulletin and Supplements; Annual Report of the Surgeon General; Manual of the Medical Department.
2. Censorship of articles written by Medical Department personnel for publication; review of current periodical medical literature; collection of pamphlet publications on hygiene, medical biography, etc.; collection of photographs and other official papers bearing on the Medical Department; preparation of articles for purposes of publicity; translations from foreign languages.

Division of dentistry.—Chief of division: Lieutenant Commander, D. C., U. S. Navy.

(a) Personnel section.—Head of section: Chief of division.

1. Complements; appointments; enrollments; assignments; standards for examinations; examining boards; instruction; promotions; resignations; liaison with division of personnel; duties of dental officers.

(b) Matériel section.—Head of section: Chief of division.

1. Allowances of dental instruments and supplies on supply table; liaison with requisition section of division of finances.

(c) Inspection section.—Head of section: Chief of division.

1. Inspection of dental activities ashore and afloat.

Division of physical requirements.—Chief of division: Commander, M. C., U. S. Navy.

(a) Physical requirements section.—Head of section: Chief of division. Assistant: Lieutenant, M. C., U. S. Navy.

1. Physical examinations of personnel; promotions; medical surveys; waivers of physical disabilities; reports of death; line of duty.

(b) Medical and health records section.—Head of section: Chief pharmacist, U. S. Navy. Assistants: Chief pharmacist, U. S. Navy; pharmacist, U. S. Navy.

1. Health records, personnel files; casualty reports; casualty lists; pension certificates; Veterans' Bureau certificates; data for: Medical examining boards; naval retiring boards, insurance and beneficial organizations; death gratuities; library of: Medical histories; medical journals; statistical records.

Division of preventive medicine.—Chief of division: Lieutenant Commander, M. C., U. S. Navy.

(a) Communicable diseases section.—Head of section: Chief of division.

1. Epidemiological reports and studies of affairs relating to the control of communicable diseases; advice on sanitation of buildings and ships; use of prophylactic vaccines and sera; quarantine and disinfection; laboratory questions relating to preventive medicine.

(b) Hygiene and sanitation section.—Head of section: Chief of division.

1. Water supply, sewerage, drainage, disposal of garbage and refuse; extermination of insects and vermin; prevention of occupational diseases; messing, bathing, and toilet facilities; food problems; sanitation of buildings, housing problems, detention and isolation facilities; sanitation and hygiene of ships; dissemination of information relative to health conditions in civilian communities adjacent to naval stations; cooperation with Federal, State, local, and other health agencies.

(c) Public health education section.—Head of section: Chief of division.

1. Publication of weekly bulletin; educational advertising measures; graphic presentation of vital statistics.

(d) Vital statistics section.—Head of section: Chief pharmacist, U. S. Navy.

1. Collection and compilation of vital statistics; checking and filing of statistical reports and Form F cards.

Division of inspections.—Chief of division: Rear Admiral, M. C., U. S. Navy. Assistant: Chief pharmacist, U. S. Navy.

1. General inspection tours of stations and activities of the medical department; general sanitary reports; recommendations as to improvements of policy.

Though having separate commanding officers the Naval Medical School and the Naval Dispensary activities are carried on in close cooperation and in accordance with the policies of the Bureau of Medicine and Surgery.

At the Naval Medical School medical and dental officers receive courses of instruction in medical officers' duties, aviation medical officers' duties, and dental officers' duties. Hospital corpsmen receive instruction in laboratory technique and procedures and in mechanical dentistry.

The Naval Dispensary provides treatment for naval personnel attached to the Navy Department and their families, renders first-aid treatment and care to the civil employees of the Navy Department and conducts special physical and other examinations.

MEDICAL DEPARTMENT PERSONNEL.

Comprising the personnel of the medical department are the members of four corps, the Medical, Dental, Hospital, and Nurse Corps. The Medical Corps is composed of medical officers, the Dental Corps of dental officers, the Hospital Corps of chief pharmacists, pharmacists, and enlisted men, and the Nurse Corps of trained nurses.

Medical and dental officers and nurses are appointed from civil life, the former by the President, by and with the advice and consent of the Senate, the latter by the Surgeon General with the approval of the Secretary of the Navy, with the exception of the superintendent who is appointed by the Secretary

of the Navy. Hospital corpsmen are enlisted or change their rating from other branches of the service to Hospital Corps ratings. Pharmacists (warrant officers) are appointed from enlisted men by the Secretary of the Navy and chief pharmacists (commissioned warrant officers) are appointed to that grade from pharmacists, being appointed by the President, by and with the advice and consent of the Senate.

For full information concerning the grades and ratings, appointments, promotions, and advancements, and the duties of the members of these corps, reference should be made to chapters 2 to 10, inclusive, and sections 2 to 9, inclusive, of chapter 12, of the Manual of the Medical Department.

ADMINISTRATION OF NAVAL HOSPITALS.

Section 1 of chapter 12, Manual of the Medical Department, explains the establishment and management of naval hospitals.

As will be noticed in paragraph 1606 of the section above mentioned, the Bureau of Medicine and Surgery has charge of the operation of all hospitals and of the force employed there. In order that commanding officers may administer naval hospitals successfully they must have the necessary personnel to accomplish that end.

In the organization of the Bureau of Medicine and Surgery as given in this chapter, among the duties of certain divisions appears complements. This means that that division or section is charged with providing the complements of officer, enlisted, nursing, and civilian personnel for naval hospital and other activities of the medical department.

Naval hospitals vary in size and, therefore, can care for varying numbers of patients. Thus they sometimes are spoken of as 100, 200, or perhaps 1,000 bed hospitals. On this bed capacity is determined the complements of the personnel of naval hospitals. The minimum medical-officer personnel for a 500-bed naval hospital as shown by the experience of years is considered to be as follows:

1 Captain, Medical Corps.....	Commanding officer.
1 Commander, Medical Corps.....	Executive officer.
1 Commander or Lieutenant Com- mander, Medical Corps.....	Chief of medical service.
1 Commander or Lieutenant Com- mander, Medical Corps.....	
13 Lieutenants or Lieutenants, junior grade, Medical Corps.....	Chief of surgical service.
	Ward officers; X-ray; laboratory; eye, ear, nose, and throat; urolo- gical; and other special duties.

Chief pharmacists and pharmacists, with the duties to be performed by each, are required as follows for a 500-bed hospital:

Chief pharmacist.....	Chief clerk of the hospital, and assist- ant to the commanding officer; gen- eral supervision of operation of hos- pital offices, and other administra- tive details.
Chief pharmacist or pharmacist.....	Accounting and property officer.
Chief pharmacist or pharmacist.....	Record and personnel officer.
Chief pharmacist or pharmacist.....	Commissary officer.
Chief pharmacist or pharmacist.....	First lieutenant of hospital, assistant to executive officer, in charge of in- struction of hospital corpsmen.

The complement of hospital corpsmen for a 500-bed hospital is based upon several factors. By law the authorized strength of the Hospital Corps is $3\frac{1}{2}$ per cent of the strength of the Navy and Marine Corps (see par. 302, Manual of the Medical Department), and the number thus obtained must be distributed in the various ratings in such a manner as to provide for the proper performance of the duties of the Hospital Corps, a rational flow of advancement in rating, and for training and instruction. Experience has shown that these conditions can be met satisfactorily by a percentage distribution in ratings as follows, which (taking $3\frac{1}{2}$ per cent of 86,000 and 19,500 Navy and Marine Corps enlisted personnel) provides the numbers in the tabulation below:

Rating.	Per cent.	Number.
Chief pharmacist's mates.....	14	516
Pharmacist's mates, first class.....	15	555
Pharmacist's mates, second class.....	22	812
Pharmacist's mates, third class.....	28	1,034
Hospital apprentices, first class.....	14	517
Hospital apprentices, second class.....	7	258
Total.....	100	3,692

These percentages ordinarily will furnish sufficient numbers in each rating to provide for the complements of hospital corpsmen on board ship with medi-

CREW	RATING					
	CPHm	PhM1c	PhM2c	PhM3c	HA1c	TOTAL
Administrative						
Clerical Department (Personnel)	1	2	0	2	3	8
Clerical Department (Matériel)	1	1	0	4	0	6
Commissary Department	1	1	2	4	0	8
Master at Arms	1	0	0	0	0	1
Assistant Master at Arms	0	0	2	0	0	2
Dispensary	1	0	2	0	1	4
Laboratory	0	1	1	0	1	3
X-ray	1	0	0	1	0	2
Physiotherapy	0	0	2	0	2	4
Linen Room	0	0	0	0	4	4
Total Administrative Crew	6	5	9	11	11	42
Nursing						
Medical Wards (4)	0	4	6	9	5	24
Surgical Wards (4)	0	4	6	9	5	24
Venereal Wards (2)	0	2	4	0	2	8
Sick Officers' Quarters	0	0	4	4	0	8
Contagious Wards	1	3	3	6	0	13
Operating Room	0	2	1	2	1	6
Total Nursing Crew	1	15	24	30	13	83
GRAND TOTAL	7	20	33	41	24	125

FIG. 203.—Duty distribution of hospital corpsmen in a 500-bed naval hospital.

cal officers or independent of medical officers on expeditionary duty with the marines and at activities ashore within and beyond the continental limits of the United States.

In assigning the complements of hospital corpsmen the Bureau of Medicine and Surgery is guided by the number of men in the crew, the personnel cared for, whether sick-bay or first-aid treatment is rendered, the nature of the duty performed, and the bed capacity. Ordinarily, one hospital corpsman is provided for each 100 of the crew of an active vessel, except on independent

No. Beds	Crew	CPhM	PhM1c	PhM2c	PhM3c	HALc	10% Addl.	TOTAL
100	Admin.	3	4	4	4	4	2	21
	Nursing	0	4	8	8	2	2	24
	TOTAL	3	8	12	12	6	4	45
200	Admin.	4	4	5	5	5	2	25
	Nursing	0	6	13	13	4	4	40
	TOTAL	4	10	18	18	9	6	65
300	Admin.	5	4	6	6	6	3	30
	Nursing	1	9	14	18	4	5	51
	TOTAL	6	13	20	24	10	8	81
400	Admin.	6	5	8	7	7	3	36
	Nursing	1	12	16	23	8	6	64
	TOTAL	7	17	24	30	15	9	100
500	Admin.	6	5	9	9	9	4	42
	Nursing	1	15	21	27	11	8	83
	TOTAL	7	20	30	36	20	12	125
600	Admin.	6	5	9	10	10	4	44
	Nursing	2	16	24	32	12	9	95
	TOTAL	8	21	33	42	22	13	139
700	Admin.	7	6	10	10	10	4	47
	Nursing	2	16	26	38	16	10	108
	TOTAL	9	22	36	48	26	14	155
800	Admin.	7	7	10	11	12	5	51
	Nursing	2	18	30	44	18	11	121
	TOTAL	9	25	40	55	30	16	172
900	Admin.	8	8	10	12	12	5	55
	Nursing	2	18	34	46	18	12	130
	TOTAL	10	26	44	58	30	17	185
1000	Admin.	8	8	12	14	16	6	64
	Nursing	2	20	36	50	20	13	141
	TOTAL	10	28	48	64	36	19	205

FIG. 204.—Complements of hospital corpsmen for naval hospitals of 100 to 1,000 beds.

duty where one hospital corpsman is assigned and the crew does not exceed 125, and one hospital corpsman to approximately every five patients in hospitals.

The complements of naval hospitals are divided into what is known as the administrative and nursing crews. To the number in each crew is added 10 per cent, distributed in the ratings of pharmacist's mate, second and third class, and hospital apprentice, first class, to allow for sickness, leave, or absence from a duty status for other reasons.

Administrative crew.—The administrative crew consists of men assigned to duties where their retention is desirable in promoting efficiency in the operation of the hospital. This crew, considered an overhead necessity, is incapable of being altered without disturbing the internal organization of the institution, and once men were assigned to it, every endeavor is made to allow them to remain there until they complete their current tour of shore duty, and reliefs generally are furnished for the higher rated men before transfer. Changes in the number of patients do not affect the number in the administrative crew.

Nursing crew.—The nursing crew may fluctuate with the number of patients but seldom is reduced below the complement authorized by the Bureau of Navigation. It consists of men assigned to duty in the various wards and the operating room.

Shown herewith are two tables giving the duty distribution of hospital corpsmen in a 500-bed naval hospital, and the complements of naval hospitals of 100 to 1,000 bed capacities. The duty distribution shows only those details considered actually essential in the proper functioning of a 500-bed naval hospital; such details as may be desirable but not absolutely necessary not appearing and the complements given are considered by the Bureau of Medicine and Surgery to be the minimum required to maintain the efficiency of the medical department and afford the proper care for the sick of the Navy and Marine Corps in naval hospitals.

Other hospitals.

In addition to permanent naval hospitals, there are mobile hospitals for expeditionary service with the marines and Navy Base Hospital units for service wherever required. The organization of mobile hospitals is given in the section on Duty with Marine Corps Expeditionary Forces.

Navy base hospital units are numbered, and the name by which they are known is United States Navy Base Hospital No. 1, etc. These units are organized by a medical officer of the Naval Reserve Force having the rank of commander. This officer, under the supervision of the Bureau of Medicine and Surgery, acts as the head and has entire charge of the organization until the unit is called into active service, when he is relieved as officer in charge by a medical officer of the Regular Navy having the rank of captain, and the organizer becomes chief of either the medical or surgical service.

A medical officer of the Naval Reserve Force having the rank of commander or lieutenant commander acts as assistant to the organizer and in his absence is considered as being in charge of the unit. When the unit is called into active service he is relieved by a medical officer of the regular Navy having the rank of commander, and becomes, by agreement with the organizer, chief of either the medical or surgical service.

The enlisted personnel of Navy base hospitals usually is composed mainly of members of the Naval Reserve Force, and their enrollment is delayed until a call to active service is imminent.

Nurses for duty with these units are selected by the organizer, enrolled by the American Red Cross Society, and assigned to duty with the particular unit whose organizer has requested them. When called into active service

all nurses assigned to the unit are transferred to and enrolled in the Nurse Corps Reserve, U. S. Navy.

NAVY BASE HOSPITAL UNITS.

ORGANIZATION.

Navy base hospitals are organized on the basis of 500-bed hospitals in the medical department of the United States Navy. Tables of organization for a base hospital of this capacity authorize: 22 commissioned officers (3 of whom will be regular Navy officers), 5 chief pharmacists or pharmacists (4 of whom will be regular Navy chief pharmacists or pharmacists), 1 pay clerk (regular Navy), 60 nurses, 214 enlisted men (47 of whom will be regular Navy).

The rank and number of the various commissioned officers, warrant officers, nurses and enlisted men are as follows:

Commissioned officers (22):

Medical officers, U. S. Navy (regular Navy)—

- 1 captain (Medical Corps).
- 1 commander (Medical Corps).
- 1 lieutenant (Supply Corps).

Medical officers, U. S. Naval Reserve Force—

- 2 commanders (Medical Corps).
- 5 lieutenant commanders (Medical Corps).
- 10 lieutenants (Medical Corps).

Dental officers, U. S. Naval Reserve Force—

- 2 lieutenants (Dental Corps).

The organization of Navy base hospitals is divided into administrative and professional divisions.

1. Administrative:

- 1 captain, M. C., U. S. Navy, in command.
- 1 commander, M. C., U. S. Navy, executive officer.
- 1 lieutenant, S. C., U. S. Navy, supply officer.
- 4 chief pharmacists or pharmacists, U. S. Navy.
- 1 pay clerk, U. S. Navy, assistant to supply officer.

2. Professional:

Surgical service (10 medical officers, U. S. Naval Reserve Force)—

- 1 chief.....Commander.
- 4 general surgeons.....2 lieutenant commanders, 2 lieutenants.
- 1 orthopedic surgeon.....Lieutenant.
- 1 G. U. surgeon.....Lieutenant.
- 2 eye, ear, nose, and throat surgeons... 2 lieutenants.
- 1 Roentgenologist.....Lieutenant.

Medical service (5 medical officers, U. S. Naval Reserve Force)—

- 1 chief.....Commander.
- 3 assistants.....2 lieutenant commanders, 1 lieutenant.
- 1 psychiatrist.....Lieutenant.

Dental service (2 dental officers, U. S. Naval Reserve Force)—

- 2 lieutenants.

Dispensary—

- 1 chief pharmacist or pharmacist, U. S. Naval Reserve Force.

2. Professional—Continued.

Laboratory service (2 medical officers, U. S. Naval Reserve Force)—

1 chief-----Lieutenant commander.

1 assistant-----Lieutenant.

Nurses (60 Nurses, U. S. Naval Reserve Force)—

1 chief nurse.

2 assistant chief nurses.

57 nurses.

Dietetic service—

1 dietitian (not necessarily a nurse).

Enlisted personnel, 214 (47 regular Navy) :

Hospital corpsmen—

(a) Administrative crew (42)—

6 chief pharmacist's mates (regular Navy).

5 pharmacist's mates, first class.

9 pharmacist's mates, second class.

11 pharmacist's mates, third class.

11 hospital apprentices, first class.

(2 of the 11 pharmacist's mates, third class, are to be designated as assistants to the dental officers.)

(b) Nursing crew (83)—

1 chief pharmacist's mate.

15 pharmacist's mates, first class.

24 pharmacist's mates, second class.

30 pharmacist's mates, third class.

13 hospital apprentices, first class.

Yeomen (7)—

2 chief yeomen (1 regular Navy).

2 yeomen, first class.

3 yeomen, second class.

1 chief yeoman assigned to commanding officer.

1 chief yeoman (regular Navy) assigned to supply officer.

1 yeoman, first class, assigned to executive officer's office.

1 yeoman, second class, assigned to supply officer's office.

1 yeoman, first class, assigned to record office.

1 yeoman, second class, assigned to chief of surgical service.

1 yeoman, second class, assigned to chief of medical service.

Cooks, etc. (13)—

1 chief commissary steward.

3 ship's cooks, first class (1 chief cook, 1 in charge of each watch).

5 ship's cooks, second class (1 butcher, 2 meat cooks, 2 vegetable cooks).

4 ship's cooks, third class.

Bakers (2)—

1 baker, first class.

1 baker, second class.

Electricians (3)—

1 chief electrician's mate.

2 electrician's mates, second class.

Blacksmiths (1)—

1 blacksmith, second class.

Plumbers (2)—

1 ship's fitter, first class.

1 ship's fitter, second class.

Enlisted personnel, 214 (47 regular Navy)—Continued.

Machinists (12)—

- 2 chief machinist's mates.
- 2 machinist's mates, first class.
- 8 machinist's mates, second class.

(1 chief machinist's mate to have charge of transportation; 1 chief machinist's mate to have charge of transportation repair. Machinist's mates to be drivers and assistant drivers for all motor transportation.)

Seamen for guard, messengers, and messmen (40)—

- 1 boatswain's mate, first class.
- 2 coxswains.

(Others to be seamen, second class, apprentice seamen, and mess attendants, all regular Navy.)

Firemen (4)—

- 1 fireman, first class.
- 3 firemen, second class.

Carpenters (3)—

- 1 chief carpenter's mate.
- 2 carpenter's mates, second class.

Painters (2)—

- 2 painters, second class.

Details of hospital corpsmen for duty in connection with X-ray work, laboratory work, physiotherapy, or other special branches of medicine are to be made by the executive officer.

CLERICAL WORK IN THE MEDICAL DEPARTMENT OF THE NAVY.

The clerical work in the medical department of the Navy required of hospital corpsmen may be explained most advantageously if separated into three divisions, as (1) general correspondence—i. e., letters, endorsements, etc.; (2) requisition and voucher forms for the procurement of supplies and services; (3) reports and returns other than requisition and voucher forms.

Correspondence.

Correspondence or written communication in the Navy may be divided into three general classes, which are official, semiofficial, and unofficial.

(a) Official correspondence is communication between officers of the Navy and the offices and bureaus of the Navy Department; commanders in chief; commandants; vessels of the Navy; naval stations; ships and stations; and with other executive departments by the office of the Secretary of the Navy. The subject matter usually embraces information concerning the activities, duties, and policies of the Navy, recommendations, reports, and knowledge of conditions in foreign countries which are of value in the transaction of public business.

(b) Semiofficial correspondence usually is the communication of information in a partly official manner to a bureau or office in the Navy Department by officers under the direct cognizance of that bureau or office.

(c) Unofficial correspondence is all communication not considered official or semiofficial.

Official correspondence and information is of three types—secret, confidential, and nonconfidential.

(a) "Secret" matter is correspondence or information which should be known only to the person addressed or to other persons to whom he is specifically authorized to communicate it.

(b) "Confidential" matter is correspondence or information which would prove of value to an enemy (or in time of peace to a foreign government), but which does not relate to measures or weapons which the United States is preparing to use against him and is not vital to the secrecy of present or future policy.

(c) "Nonconfidential" matter is correspondence or information which relates to methods of procedure regularly followed and to other subjects a full knowledge of which could by no possibility be of use to an enemy. (See Art. 2005, N. R.)

Official correspondence within the naval service is carried on in the manner prescribed in detail by the Navy Regulations (chapter 52, art. 2003, et seq.). While the substance of official correspondence concerning the medical department of the Navy is determined by the officers charged with such duty, its transcription into official form for signature and forwarding usually is entrusted to hospital corpsmen. For one preparing correspondence, it is most important to remember to keep a copy of every letter or endorsement prepared and to have a systematic method of numbering and filing all such papers, so that they can be referred to readily.

A hospital corpsman detailed to perform clerical work should have access to a copy of the Naval Regulations, and the instructions in chapter 52 thereof should be referred to whenever there is any doubt as to the proper form to be used or the method of procedure to be followed, the intention here being to describe only so much of the official instructions as will make clear the essential features of service correspondence by letter or endorsement.

Correspondence must be courteous in tone and free from expressions of a personal nature, but courtesy shall be indicated by the substance and feeling rather than by artificially polite phrases and formulas.

So far as is possible, and with due consideration of the public interests, the number of letters written and their length should be minimized. Accuracy, simplicity, and conciseness, especially in official correspondence, and confining letters to the one subject at hand without omitting necessary details and arranging the paragraphs of letters in logical sequence is most essential. If adding to the clearness of a letter, the use of accompanying diagrams, tables and sketches is permissible, but they should never be embodied in the letter.

Communications from subordinates are sent to their superior officers for transmittal. If in proper form and language, the superior officer forwards them as soon after receipt as practicable, stating thereon in writing, by endorsement or otherwise, his opinion in relation to every part of the subject contained in the communication.

To such papers as are complete in themselves and do not require an expression of opinion from the office through which they are transmitted, the term "forwarded" may be affixed and such papers transmitted under the endorsement of an officer of the staff, by direction of the commander in chief, the commandant, or the senior officer present.

As a general rule, letters shall be answered by letters and not by endorsement. This does not prevent the use of stamped or written endorsements on papers or reports copies of which are not retained, or the use of endorsements on papers necessarily referred to several bureaus or offices. This is intended to prevent unnecessary clerical work. When the original is answered by a separate letter each office has a complete record of the correspondence without extra work. Separate letters shall be written on separate subjects unless the subjects are of a like nature. The subject matter in a letter should be divided into paragraphs in logical sequence, each containing statements com-

plete in themselves but all relative and pertinent to the subject at hand, and the paragraphs numbered.

All communications, except such as require neither action nor reply, shall be acknowledged.

Letters and endorsements shall be numbered and shall be typewritten if practicable, using noncopying ribbons and making a sufficient number of carbon copies for filing or other purposes. If correspondence can not be typewritten, it should be written legibly and contain no erasures or interlineations. Carbon copies shall show the office of origin and the name of the signing officer shall be typewritten or stamped on all copies. In preparing letters, endorsements, and reports which go through another office or other offices, the office preparing the original will make on thin white paper a copy for each office through which the correspondence is to pass before it reaches its final destination. These copies will be marked for the appropriate office.

Letter paper habitually is used for official correspondence in the Navy, whether letters or endorsements. For the original or first copy, it is white linen typewriter paper, 8 by 10½ inches in size, weighing approximately 4½ pounds per ream of 500 sheets of that size. For file copies, a green tinted paper of the same size and weighing about 3 pounds per ream is used. Thin paper other than green is used for additional carbon copies.

Typewriter cap, used only in special cases, shall be 8 by 13 inches in size, but otherwise similar to letter paper.

The paper used for letters and endorsements has two holes punched in it, the center of the holes one-half inch from the top of the sheet and 2¾ inches apart and equidistant from the center of the sheet. These holes permit the sheets to be fastened together uniformly.

The first sheet of a letter or a report shall be placed on the bottom and additional sheets in regular order, so that the last sheet is on top. Enclosures, if any, shall be placed on the bottom, and the whole securely fastened together with paper fasteners, the ends of which shall be on the top so that the upper sheet may be removed to place endorsements thereon, or add additional sheets. When a following endorsement begins on a new sheet the subject shall be repeated. Each page of letters and endorsements shall be numbered consecutively throughout, and the numbers shall be placed in the middle of the page about one-half inch from the bottom.

When necessary, letter paper shall be folded in three and typewriter cap in four equal folds parallel to the writing.

“(1) The forms prescribed in this article shall apply to all correspondence within the naval service, with the State naval militia organizations, and with such departments as may adopt a similar form of correspondence, but not with departments, officials, and persons that have not adopted these or similar forms.

“(2) Letters shall begin with the ship or station, place, and date, grouped and spaced as indicated in the examples in paragraph 27. The upper line of the heading shall be at least 1½ inches from the top of the page. In the case of endorsements which start on a new page, or any letter or endorsement continued on a new page, there shall also be left clear at least 1½ inches at the top for binding purposes.

“(3) The official designation of all vessels of the Navy shall be the name of the vessel preceded by the letters U. S. S. The word ‘flagship’ shall follow the name of the vessel in the heading of a communication emanating from the office of a flag officer.

“(4) Special subletterheads may be used at shore stations to designate the different offices of the station, and by officers on detached duty ashore, but

shall not be used to designate the different heads of departments on board ship. (See Example B and the last two examples under C.)

"(5) In communications dated on board a vessel at sea, the latitude and longitude shall be stated if exactness be necessary, otherwise the expression 'Passage, to—' shall be used.

"(6) Following the heading and date in letters and endorsements either the official designation or the name and rank of the writer preceded by the word 'From' shall be written at the left side of the page as indicated in examples in paragraph 27.

"(7) On the line below 'From,' and preceded by 'To' at the left of the page, shall appear the official designation of the office or official addressed; following this the channel through which the communication is to pass; these offices to be designated by numerals indicating the sequence of routing.

"(8) Following the address, the subject of the correspondence, briefed, shall be written across the page, preceded by 'Subject.'

"(9) The brief of the subject should be written in about the same form and terms as would be used in indexing the communication in filing; for example, 'Delaware; feed pumps; recommends change in type.' 'Navy Yard, New York; Dry dock No. 1; reports damage to caisson struck by tug.'

"(10) The subject shall not be repeated at the beginning of an endorsement, except when required by the filing system of the writer's office to identify the file copy, or when the endorsement begins on a new sheet, in which case it shall always be repeated.

"(11) After the subject the references to previous correspondence on the same subject, if any, shall be briefly indicated, preceded by 'Reference,' as shown in the form in paragraph 27.

"(12) In acknowledging, answering, or referring to official communications, the file number (letters as well as figures) and date shall be included in the 'Reference.' References shall be lettered in small letters, and may be referred to in the communication as 'Reference (a),' etc.

"(13) When a plan that has been given a file number is referred to in the correspondence, this number should be stated in connection with such reference.

"(14) Following 'Reference,' if any, the number of enclosures shall be stated, preceded by 'Enclosure,' at the left of the page, as indicated in the example in paragraph 27.

"(15) The use of numbered enclosure slips attached to the enclosures is authorized, and in case they are used the serial number of the slip or slips should be given after the word 'Enclosures.' (See Example B.)

"(16) When necessary, the method of forwarding enclosures, whether enclosed under separate cover or by express, shall be indicated. The absence of 'Reference' or 'Enclosure' will indicate that no reference or enclosure accompanies the communication.

"(17) The file number of the letter or endorsement shall be placed in the upper left corner, about 1 inch from the top and 1 inch from the left edge of the page; the abbreviation or initials of the section or division preparing the correspondence to follow on the same line as the file number.

"(18) The body of letters and endorsements shall be written single spaced, with one double space between paragraphs. Each endorsement shall, where possible, be written on the same sheet as the preceding letter or endorsement, with a space of about one-half inch intervening.

"(19) Paragraphs in letters and endorsements or other official papers shall be numbered. Subparagraphs shall be lettered thus: (a), (b), etc.

"(20) The body of the letter shall begin and end without any ceremonial form or expression, such as 'Sir,' 'I have the honor to report,' 'Very respect-

fully,' etc., and shall be followed by the signature of the writer without designation of rank, title, or office. Information will be imparted, reports made, and questions asked directly, dispensing with such introductory phrases as 'The bureau informs you that,' 'Information is requested as to,' 'It is directed,' etc.

"(21) In the body of the letter U. S. Navy shall be abbreviated to U. S. N., U. S. Naval Reserve Force to U. S. N. R. F., U. S. Marine Corps to U. S. M. C., and U. S. Marine Corps Reserve to U. S. M. C. R. In the case of names of officers of the Staff Corps the designations as given in article 148 shall be abbreviated as follows: Medical Corps to M. C., Supply Corps to S. C., Medical Corps Dental Surgeons to M. C. D. S., Construction Corps to C. C., Civil Engineer Corps to C. E. C., Chaplain Corps to Ch. C., Professors of Mathematics to Math.

"(22) When any article referred to in a communication is forwarded under separate cover it shall be tagged and plainly marked in the following manner: 'From: Commanding Officer, U. S. S. -----, accompanying letter (or endorsement) No.-----, date-----.' If possible this shall appear also on the box or package carrying the enclosure.

"(23) Stamps showing the date of receipt of papers shall be so placed as not to occupy any writing space. If stamps constituting pro forma endorsements, such as 'Received and forwarded,' 'Referred for action,' etc., are used, they will be placed on the face of pages as though written in a more formal manner, and will be numbered as indicated in example.

"(24) Endorsements, whether written or stamped, except those referred to in the next paragraph, shall be placed in regular order, beginning on the last page of the letter, immediately below the signature, if there be room there, if not, additional full sized sheets shall be appended to the letter to accommodate them. Endorsement slips shall not be used, except on correspondence with other departments using such slips.

"(25) All endorsements affecting pay, mileage, transportation, and traveling expenses shall be placed on the face of the original order involving travel, if practicable, otherwise on the back of the order. Such endorsements shall never be placed on sheets which might be detached from the original order.

"(26) Only one page of the sheet shall be written upon, and a margin of three-fourths inch shall be left on each side and at the bottom of the sheet.

"(27) The following are examples of the forms of correspondence prescribed in this article:

Example A.

No. 122-3.

U. S. NAVY YARD, PHILADELPHIA,

30 June, 1920.

From: Commandant, Navy Yard, Philadelphia.

To: Commanding officer, U. S. S. *Southwark*.

Via: (1) Construction officer.

(2) Engineer officer.

Subject: U. S. S. *Southwark*—Repairs to boat crane.

References: (a) Comdg. Off. let. No. 576-D, of 27 April, 20.

(b) Dept. let. 2345-432, of 30 April, 20.

Enclosures (herewith): (a) Blueprint No. 1234 showing proposed arrangement of boat crane.

(b) Copy of previous correspondence on this subject.

1. The repairs to the boat crane of the U. S. S. *Southwark* are to be undertaken by the ship's force. The yard force will give such assistance as may be necessary in this connection, and you will please be governed accordingly.

A. B. -----

1st. endorsement.

No. 324-8-OD.

U. S. NAVY YARD, PHILADELPHIA,
CONSTRUCTION DEPARTMENT,

1 July, 1920.

From: Construction officer.

To: Commanding officer, U. S. S. *Southwark*.

Via: Engineer officer.

Subject: U. S. S. *Southwark*—Repairs to boat crane.

1. The commanding officer has been consulted concerning the desired repairs, and the necessary material therefor under the construction department will be furnished.

2. Estimated cost:

Labor -----	\$10
Material -----	80
Indirect -----	40
Total -----	130

C. D. -----

2nd. endorsement.

No. 411-237-PW

U. S. NAVY YARD, PHILADELPHIA,
ENGINEERING DEPARTMENT,

5 July, 1920.

From: Engineer officer.

To: Commanding officer, U. S. S. *Southwark*.Subject: U. S. S. *Southwark*—Repairs to boat crane.

1. The construction officer and commanding officer have been consulted, and the necessary material under the engineering department for the proposed repairs will be furnished.

2. Estimated cost:

Labor -----	\$8
Material -----	60
Indirect -----	30
Total -----	98

E. F. -----

Example B.

1382-67-C. O.

NAVY YARD, PUGET SOUND, WASH.,
HULL DIVISION,

6 May, 1920.

From: Construction officer.

To: Commandant.

Subject: Quick-drying paint.

References: (a) Bureau C. & R. letter 4048-A-306 of 14 March, 20.

(b) Bureau C. & R. letter 4048-A-139 of 27 July, 19.

(c) Bureau C. & R. letter 1808-B-912 of 12 Feb., 20.

Enclosures: No. 13821 and No. 13822.

1. I request that the Bureau of Construction and Repair furnish formula for manufacturing slate-color, quick-drying paint mentioned in the first paragraph of reference (c).

2. Also request information as to the proper formula for boot topping on battleships. The second paragraph of reference (c) states that black, quick-drying paint is used for boot topping on vessels painted slate color. Reference (b) gives black boot topping formula for use on torpedo boats, destroyers, and colliers, but states nothing about modifying previous instructions regarding boot topping for battleships, the last instructions received on that point being in reference (c). Attention invited to enclosure No. 13822 showing samples of boot topping used on ships at the yard and that mixed according to reference (c).

A----- B-----

1st. endorsement.

12879-136-c.

NAVY YARD, PUGET SOUND, WASH.,

7 May, 1920.

From: Commandant.

To: Bureau of Construction and Repair.

Subject: Quick-drying paint.

Enclosure: No. 13822.

1. Approved and forwarded.

E----- F----- G-----

Example C.

(Form of letterheads and subletterheads.)

NAVY DEPARTMENT,
BUREAU OF CONSTRUCTION AND REPAIR,
Washington, D. C., 1 July, 1912.

U. S. S. CONNECTICUT,
HAMPTON ROADS, VA., 1 July, 1912.

UNITED STATES ATLANTIC FLEET,
U. S. S. CONNECTICUT, FLAGSHIP,
NAVY YARD, NEW YORK, 1 July, 1912.

U. S. S. CONNECTICUT,
Passage, New York to Hampton Roads,
1 July, 1912.

NAVY YARD, NEW YORK,
CAPTAIN OF THE YARD'S OFFICE,
1 July, 1912.

NAVY YARD, BOSTON,
HULL DIVISION,
1 July, 1912.

NAVY YARD, NORFOLK,
MACHINERY DIVISION,
1 January, 1913."

To expedite public business between offices of the department or within any command, mail is regarded as consisting of three classes—urgent, important, and ordinary. Urgent mail is given precedence over all other, and in order

that it readily may be distinguished, it has affixed to it a red slip, 2 by 3 inches in size, with "URGENT" printed thereon. "Important" mail receives precedence after urgent mail and bears a blue slip with the word "Important" thereon. In general, ordinary mail is handled in the order in which received.

Whenever the amount of business of an office justifies it as an economical measure, printed letterheads and forms for official correspondence may be used. Such forms should conform to the instructions in chapter 52, Navy Regulations, whenever applicable, and should be on sheets of standard size (letter or cap) or multiples thereof when practicable.

All papers of whatever nature which by law or regulation must be signed, approved, or forwarded by an officer commanding a fleet, squadron, division, or station, the commandant of a naval station, the senior officer present, or the commanding officer of a ship, actually must be signed by such officer in his own handwriting. In his absence they shall be signed by the line officer next in rank and actually in command at the time, and the word "Acting" shall be written or stamped after his signature, but the title of the official from whom the communication emanated, as indicated after the word "From" at the beginning of the paper, shall not be modified. The name of the officer signing also shall be typewritten or stamped. Thus, in the absence of the Chief of the Bureau of Navigation, the words "Bureau of Navigation" still would appear in the letterhead, and the acting chief of bureau would write "Acting" after his signature. "Acting" shall not be used by officers left in command of ships or divisions.

When the officers in charge of sections of a bureau or office are authorized to sign mail of their section, they write or stamp the words "By direction" after their signature, and the title of the bureau or office shall appear in the prescribed place at the head of the communication.

Communications generally are addressed to those who by regulation or law have cognizance of the subject presented or are authorized to take action thereon.

Official communications intended for officers holding positions with recognized titles are addressed to them by title and not by name, as "The Commandant," "The Commander in Chief, —— Fleet (or Squadron)," "The Commander, —— Squadron (or Division)," "The Commanding Officer."

Officers left in temporary command of a station, fleet, squadron, or division, or in general, of any command, are addressed as if they were the regular commanding officer, on the principle that it is the office and not the person that is addressed. The temporary incumbent transacts the business so that the necessary copies and records shall be preserved in the files of the absent superior officer's office, using stationery of that office when practicable.

Official mail received on board ship, or at any station, shall be opened at once by the officer actually in command for the time being, or his designated representative, and all papers requiring prompt action given immediate attention.

Official communications for the Navy Department or any of its bureaus or offices are addressed directly to the bureau or office which has cognizance over the subject matter.

It is prohibited to address communications to "The Navy Department" or to "The Navy Department (———)."

The following are examples of authorized addresses:

The Secretary of the Navy.

The Assistant Secretary of the Navy.

The Chief of Naval Operations.

The President of the General Board.
 The Chief of the Bureau of _____.
 The Major General Commandant, Marine Corps.
 The Judge Advocate General.
 The Chief Clerk of the Department.

When papers are addressed erroneously and reach any bureau or office under the jurisdiction of the Navy Department they are turned over to the bureau or office to which they should have been properly addressed without action thereon.

No written communication is official which has not been forwarded through the prescribed channels and with the endorsements of the officers through whom it should have been forwarded.

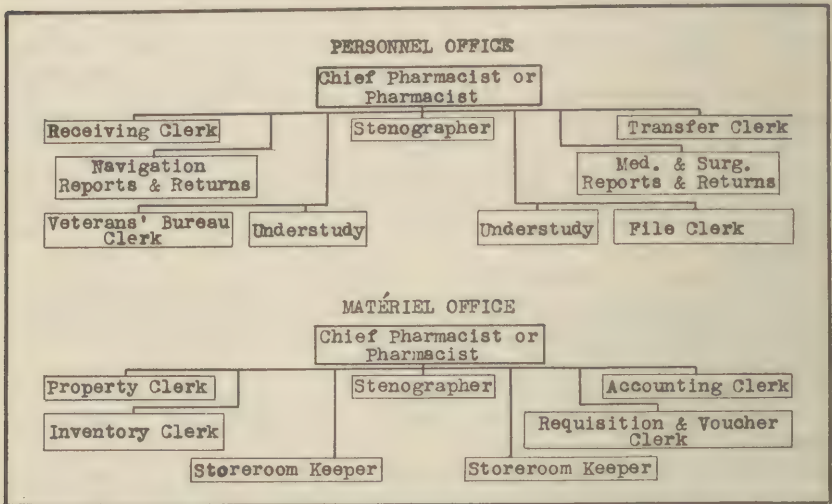


FIG. 205.—Suggested organization of personnel and matériel offices in 500-bed naval hospitals.

All officers are required to file and preserve all official documents received and copies of all official letters and endorsements sent.

Suitable files containing copies of all orders given and official letters written and the original of all letters received on public service in all offices on board naval vessels and at shore stations shall be kept and preserved. Commanding officers may take copies of orders or letters sent and received. The system of filing shall be such as to safeguard all official papers and to render them readily accessible to reference. A flat filing system shall be used when practicable.

Organization of clerical force.

The clerical work required of the medical department of a ship or hospital is carried on by members of the Hospital Corps. When hospital corpsmen are on independent duty the preparation and forwarding of the various reports and returns required is entirely in their care, and unless they have prepared themselves for this work it is very confusing to the bureau and entails an

unnecessary work in the attempt to gather accurate data from incorrect and carelessly made reports.

The duties in a naval hospital comprise all that relates to the replenishment of supplies, the upkeep, expenditure, and survey of property, the commissary department and the correspondence and clerical work of the record section incident to the above, as well as the filing of all permanent records. The record section usually is divided into two offices—personnel and matériel. Clerical work in the commissary department necessarily becomes a part of the matériel office records.

These offices, each having a pharmacist in charge and a sufficient number of hospital corpsmen and civil employees to properly carry on the work, are under the general supervision of the executive officer.

The outlines illustrated are suggestions only as to the organizations which are considered capable of handling the work of these offices in a 500-bed hospital. Selection of the personnel is dependent upon that available.

Aboard ship the clerical work comprises all the work required at naval hospitals, except commissary, and is not divided. A chief pharmacist's mate is usually in charge, the whole under the supervision of the senior medical officer.

The Bureau of Medicine and Surgery filing system.

The filing system adopted by the Bureau of Medicine and Surgery is based upon a system first devised by Capt. M. F. Gates, Medical Corps United States Navy. It is recommended for use at all medical department activities and possesses the following advantages:

(a) Uniformity. The system is capable of adaptation to meet the requirements of all naval hospitals, other shore stations, and ships, thereby doing away with the necessity of men going from one station to another being required to learn a new system of filing, having to familiarize themselves only with the minor differences due to local needs.

(b) Flexibility. It can be expanded or modified to meet local requirements and readily permits of cross filing.

(c) Accessibility. Correspondence always is obtained easily and not misplaced or lost readily.

(d) Automatism. Briefing of correspondence is unnecessary as the system is self-indexing.

(e) Divisibility. The system can be separated to permit the maintenance of files for any class of subject matter, as personnel, matériel, etc.

(f) Ease of comprehension. By carefully following the permanent index inexperienced men easily can comprehend the system and locate or file correspondence.

As will be seen from the example given below this filing system consists, fundamentally, of two grand divisions—personnel and matériel—representing as the names indicate, correspondence pertaining to those subjects and having the respective key letters of P and M.

After preparing the permanent index and marking the cardboard folders in which correspondence is filed to meet local requirements, the correspondence is secured to one side of the folder by means of a suitable paper fastener. The subjects should be separated by heavy index division cards. Once filed, correspondence should never be removed from the folder for reference, as the folder should be used as a bound book,

PERSONNEL SECTION. KEY LETTER "P."

SUBJECT.⁴SUBHEAD.⁵

- | | |
|--|---|
| <p>1. Medical officers. Duty-----</p> <p>2. Hospital Corps. Duty-----</p> <p>3. Nurse Corps. Duty-----
 (This file should be in custody
 of chief nurse. See sec. 15, chap.
 5, Manual of the Medical Depart-
 ment.)</p> <p>4. Patients, enlisted, Navy and Marine-----</p> | <p>1. Appointment. Reporting for duty.
 2. Promotion. Examinations. Fitness reports,
 etc.
 3. Orders. Detachment, etc.
 4. Conduct. Adverse reports.
 5. Health records. Physical tests.
 6. Leave.
 7. Discharges. Deaths. Retirements.
 8. Duties. Details. Instruction.
 9. Pay. Finances. Effects. Mail, etc.
 0. Miscellaneous.
 A. Inquiries from outside sources.
 B. Special commanding officer's file.
 C. -----</p> <p>1. Enlistments. Reporting for duty.
 2. Advancement in rating. Examinations. Effi-
 ciency. Special qualifications.
 3. Transfers. Orders.
 4. Conduct. Courts-martial. Punishments.
 5. Health records. Physical condition.
 6. Leave.
 7. Discharges, etc. Deaths. Surveys.
 8. Duties. Details. Instruction.
 9. Pay. Finances. Pay accounts. Allotments.
 Insurance. Mail, etc.
 0. Miscellaneous.
 A. Inquiries from outside sources.
 B. Organization. Vacancies. Complement.
 C. -----</p> <p>1. Appointment. Reporting.
 2. Promotion. Examination. Efficiency.
 3. Transfers. Orders.
 4. Conduct.
 5. Health records. Physical examinations.
 Physical condition, etc.
 6. Leave.
 7. Discharges. Deaths. Surveys.
 8. Duties. Details. Instruction.
 9. Pay. Finances. Accounts. Mail, etc.
 0. Miscellaneous.
 A. Inquiries from outside sources.
 B. Organization. Vacancies. Complements.
 C. -----</p> <p>1. Admission.
 2. Transfer from hospital.
 3. Discharge from service. Surveys.
 4. Conduct. Punishment. Courts.
 5. Health records. Physical condition.
 6. Leave.
 7. Death. Burial. Shipment of remains.
 8. Inquiries from outside sources.
 9. Pay. Finances. Effects. Mail. Allotments.
 Insurance. Pay accounts.
 0. Miscellaneous.
 A. Misconduct reports.
 B. Subsistence.
 C. -----</p> |
|--|---|

⁴ Add new subject when the need becomes apparent or alter those given to meet local conditions or needs.

⁵ Subhead numbers can be added, and subhead numbers left blank on this outline may be filled in when necessary.

SUBJECT.	SUBHEAD.
5. Patients, officers, Navy and Marine and Navy nurses.	1. Admission. 2. Transfer from hospital. 3. Discharge from service. Surveys. 4. Conduct. Punishment. Courts. 5. Health records. Physical condition. (These " are confidential in case of nurses.) 6. Leave. 7. Death. Burial. Shipment of remains. 8. Inquiries from outside sources. 9. Pay. Finances. Effects. Allotments. In- surance. Pay accounts, etc. 0. Miscellaneous. A. Misconduct reports. B. Subsistence. C. -----
6. Patients, supernumerary-----	1. Admission. 2. Transfer from hospital. 3. Discharge from service. Surveys. 4. Conduct. Punishment. 5. Health records. Physical condition. 6. Leave. 7. Death. Burial. Shipment of remains. 8. Inquiries from outside sources. 9. Pay. Finances. Effects, etc. 0. Miscellaneous. A. Subsistence. B. -----
7. Civilian employees-----	1. Employment of. 2. Pay. 3. Leave. 4. Retirement. 5. Compensation for injuries. 6. Department reports. 7. Miscellaneous. 8. -----
8. Instructions, reports and returns. Forms. Civil authorities.	1. Bureau of Medicine and Surgery circular let- ters. 2. Bureau of Navigation circular letters. 3. Commandant's orders. 4. Commanding officer's orders. 5. Miscellaneous orders. 6. Reports and returns, Medicine and Surgery. 7. Reports and returns, Navigation. 8. Reports and returns, civil authorities. Vital statistics, quarantine, etc. 9. Sanitary reports. 0. Miscellaneous. A. Public health officer's reports. B. -----

MATÉRIEL FILE. KEY LETTER "M."

1. Reservation-----	1. Land and grounds. Acreage. 2. Walks. Fences. Roads. 3. Trees. Vegetation. Seeds. 4. Sewerage system. 5. Crematory. 6. Water supply. 7. Tennis courts and playgrounds. 8. Miscellaneous. 9. -----
---------------------	---

SUBJECT.

SUBHEAD.

- | | |
|---|--|
| 2. Buildings and construction. | Repairs. 1. Main building, and repairs to.
2. Adjoining wards.
3. Mess halls.
4. Power house.
5. Laundry.
6. -----
7. (Use subhead for each additional structure of importance.) |
| 3. Quarters, and fittings for----- | 1. Commanding officer's.
2. Executive officer's.
3. Junior medical officers'.
4. Pharmacists'.
5. Nurses'.
6. Hospital Corps'.
7. Civil employees'.
8. ----- |
| 4. Cemetery and care of dead----- | 1. Cemetery. Plans and plots.
2. Headstones.
3. Digging graves.
4. Caskets.
5. Disinterment.
6. Embalming and contracts with undertakers.
7. Transportation. Ferriage and tolls for dead.
8. ----- |
| 5. Hospital departments and equipment | 1. Furniture and furnishings.
2. Dispensary. Equipment and medicines.
3. Laboratory and equipment.
4. Operating room and equipment.
5. Hydrotherapy and equipment.
6. Library and equipment.
7. Offices and equipment. Blank forms. Printing and all supplies.
8. Laundry and equipment. Washing. Linen.
9. X-ray and equipment.
0. ----- |
| 6. Ambulance and delivery service.
Live stock. | 1. Motor vehicles.
2. Repairs.
3. Gasoline. Oil.
4. Other vehicles.
5. Horses and other live stock.
6. Hay. Grain. Provender. Harness. Veterinary.
7. Freight and ferriage. Tolls.
8. ----- |
| 7. Power plant and utilities----- | 1. Machinery and equipment. Power house.
2. Electric current.
3. Tools, all classes.
4. Telephones.
5. Fire protection apparatus.
6. Communications system.
7. Refrigerating system.
8. ----- |
| 8. Commissary-----
(This file usually is kept in the commissary office.) | 1. Equipment.
2. Ice and fuel.
3. Provisions, supply department.
4. Provisions, open purchase.
5. Deliveries. Shipments. Dealers' bills.
6. Rejections. Unsatisfactory service.
7. Miscellaneous.
8. ----- |

SUBJECT.

SUBHEAD.

- | | |
|---|--|
| 9. Civil hospitals under contract----- | 1. Use a subnumber for each civil hospital under contract and file all business correspondence pertaining to that hospital under the appropriate subnumber. |
| 10. Requisitions and returns ⁶ ----- | 1. Current open-purchase requisitions.
2. Blanket requisitions (open purchase).
3. Medicine and surgery requisitions, Forms B and 4.
4. Stub requisitions.
5. Job orders.
6. Dealers' bills.
7. Vouchers.
8. Bills of lading. Shipments.
9. Property surveys, Form Ca.
0. Property inventories, Form D.
A. ----- |

Most stations having special files for forms which are satisfactory, it is not necessary that bureau forms be filed with the general correspondence.

As examples of how this system is used the following are given:

1. It is desired to write a letter relating to the advancement in rating of a hospital corpsman. Reference to the index, personnel section, shows that the subject number for Hospital Corps is 2, and the subhead number pertaining to their advancement in rating is also 2. Therefore the file number to be placed on the correspondence is P-22. (P for Personnel, 2 for Hospital Corps, and 2, Advancement in rating.)

2. Again, a circular letter from the Bureau of Medicine and Surgery pertaining to the advancement in rating of hospital corpsmen is received. Here is a double subject (*a*) Circular letter, Bureau of Medicine and Surgery; and (*b*) Advancement in rating, Hospital Corps. It is very important that all circular letters be kept in numerical order on a special file; therefore the letter should be placed under the file number P-71 (circular letters, Bureau of Medicine and Surgery), but a copy of this letter also should be made and placed under the file number P-22 (Advancement in rating, Hospital Corps). For letters which are not important and which go under more than one subject it is not necessary to copy the whole letter but simply brief it, filing the brief under the additional subject.

3. Now, for example, under the "Matériel file." It is desired to write a letter regarding the construction of an addition to the commanding officer's quarters, or one is received. The "M" index gives the subject number 3 (quarters) and the subhead 1 (commanding officer's quarters). The file number then is M-31.

Thus, at the end of a year there is in the files a series of booklets, each booklet containing all the correspondence under a given subject for the entire year. The cardboard folders act effectively as binders and may be lettered on the front in the same manner as a book is titled.

⁶ Need not be used unless correspondence relating to requisitions, vouchers, etc., is filed with the general correspondence.

BLANK FORMS AND RETURNS OF THE MEDICAL DEPARTMENT OF THE NAVY OTHER THAN REQUISITION AND VOUCHER FORMS.

To secure uniformity and accuracy of the reports and returns connected with the duties of the medical department of the Navy certain blank forms for specific purposes have been established. To designate these forms they are lettered or numbered, and they usually bear other letters indicating that they belong to the Bureau of Medicine and Surgery.

The data contained in these reports are the basis for all of the bureau's statistical compilations, and become permanent and highly important records of the Navy Department. The Bureau of Medicine and Surgery is compelled to rely upon them for the medical histories of the officers and enlisted men of the Navy when requested to furnish specific information of importance demanded by other departmental bureaus and of vital concern to the individual. It therefore is obvious that these reports must be without error. In combining and tabulating these reports an error in any one makes the whole faulty and impairs any deductions made from such statistics.

To assure the uniformity and accuracy desired and to aid those who prepare these forms, detailed instructions for preparing each particular form are printed on the form itself, or the information desired is fully indicated in the printing and wording of the form. A great difficulty with printed instructions of this character is that men for whose guidance they are intended do not read them and of course do not comply strictly with the directions given. Only by strict compliance with instructions can mistakes and needless correspondence be avoided. Before attempting to prepare any bureau form or report it is therefore essential to read carefully the instructions pertaining to the form and to understand their meaning.

As these forms, as well as the instructions for preparing them, are subject to change, the form itself should be resorted to for the necessary directions in its preparation.

REQUISITION AND VOUCHER FORMS.

In procuring supplies in the medical department of the Navy it is necessary to determine the source from which the supplies are to come. That is, are they carried in stock or can they be furnished conveniently by a naval medical supply depot; are they kept in stock for issue by a supply officer; or will it be necessary to purchase them in an open market? To procure supplies from any of these sources a requisition is required, and the source from which they are to be obtained decides the proper form of requisition to be submitted. The several forms in use by the medical department of the Navy therefore may be classed as follows:

- | | |
|------------------------|--|
| 1. Supply depot----- | Form B.
Form B-dental.
Form Ba.
Form 4. |
| 2. Open purchase----- | Medicine and Surgery Form No. 1 (supplies and services on shore).
Supplies and Accounts Form No. 44 (supplies and services afloat). |
| 3. Supply Officer----- | Stub requisition.
Supplies and Accounts forms, ashore and afloat. |

The Bureau of Medicine and Surgery maintains naval medical supply depots at Brooklyn, N. Y., Mare Island, Calif., and Canacao, P. I., from which most of the medical supplies used in the Navy are furnished. Medical supplies are purchased in large quantities by the Bureau of Supplies and Accounts on requisitions submitted by the supply depot at Brooklyn, N. Y., and approved in the usual way by the Bureau of Medicine and Surgery. Shipments are sent from Brooklyn to the other depots, because of the greater facilities for purchase in the eastern United States. These supplies are stored and issued to the medical departments of the several ships and stations from time to time upon approved requisitions.

An open-purchase requisition, as the name indicates, is one under which the supplies are to be purchased in the open market after competition. Certain classes of medical supplies are exempt by law from newspaper advertisement, but none may be purchased except by the proper representative of the Bureau of Supplies and Accounts after competition between two or more dealers by means of proposals or bids, and all purchases and payments are made by that bureau.

Any stores carried in stock by a supply officer for issue in the service may be procured on stub requisitions (S. & A. form) prepared and submitted by the head of the department concerned.

Requisitions concerning the medical department of a ship, hospital, or other shore station, are numbered in series throughout the fiscal year, which begins on July 1 and ends on June 30 of the following year. On June 30 of each year, therefore, the series for one fiscal year becomes complete, and series for the next begins on July 1. Requisitions chargeable against the Naval Hospital Fund or the appropriations, Medical Department, Contingent, Medicine and Surgery, Bringing Home Remains of Officers, etc., and Care of Hospital Patients, have one series of consecutive numbers; open-purchase requisitions, whether prepared on S. & A. Form 44 or N. M. S. Form 1, are included in the regular numerical series; and all requisitions on medical supply depots are carried in another numerical series, the numbers preceded by the letters S. D. Stub requisitions are numbered in accordance with instructions of the local supply department on which the requisition is made. Requisitions involving appropriations other than those mentioned above are forwarded unnumbered. If a requisition is canceled its number shall not be used again during the fiscal year. Duplication of requisition numbers in one fiscal year is a common occurrence and should be scrupulously avoided. Such duplication of numbers causes confusion both in the bureau and in the offices handling the requisitions, complicates any correspondence that may become necessary in connection with such requisitions, and duplication is an evidence of inexcusable carelessness in the clerical department concerned.

Items of requisitions are numbered at the left and item numbers of public bills must be identical, item for item, with the requisition item numbers.

Requisition for stores from a supply depot.

A supply table and field supply table of the medical department of the Navy are issued by the bureau as a basis for preparing requisitions for stores from supply depots. They contain a printed list, arranged alphabetically and by classes, of supplies kept on hand for issue, with allowances based on the complement of men on a ship or station. The field supply table contains a list of all articles necessary for the equipment of a field hospital, regimental hospital, battalion, and company. This field supply table is to be inserted and securely fastened to the supply table.

Every office where requisitions of the medical department are prepared should have a copy of the supply table (with the field supply table inserted) available for reference.

Full instructions for preparing requisitions for stores to be drawn from a supply depot are printed on the several forms, and these instructions must be followed in each instance. Additional information is contained in chapter 20 of the Manual of the Medical Department.

A brief description only of these requisition forms is given here.

Form B contains a printed list of the medical supplies as given in part one of the supply table, and is intended for use when a large number of articles is required.

Form B-dental contains a printed list of dental supplies listed in part two of the supply table, and is intended for the use of dental officers only.

Form 4 is a blank form to be used when a limited number of articles in the supply table is required; also for indispensable articles not on Form B which can be furnished most conveniently by a supply depot. Separate requisitions must, however, be prepared in each instance for articles listed in parts one, two, and three of the supply table and for articles not listed in the supply table. The latter requirement is important and should be adhered to strictly, for the reason that supply depot accounts are kept in accordance with this classification. When a Form 4 requisition is submitted for articles not on the supply table it should be accompanied by a letter explaining the necessity for such articles.

Form Ba is a special requisition form embracing a supplementary list of articles (on charge but not included in the supply table) in store at the naval medical supply depot.

These four separate forms, B, B-dental, Ba, and 4, are prepared in quadruplicate (and retained copy), giving the number of the requisition, and marked "First," "Second," "Third," "Fourth." The name of the appropriation is not entered by the maker. They should be forwarded for approval as directed on the forms. No money values are to be entered by the maker on the face of any supply depot requisition, since the stores are purchased in the open market on requisitions for the supply depot and their issue value determined in that way. When priced in the supply depot the first and second are returned to the maker of the requisition as invoices, and he is to enter the values on the third. After receipt of the stores the forms are signed by the receiving officer, and they then become vouchers. The "first" is returned to the supply depot, the "second" to the bureau, and the "third" is retained for the files of the ship or station. The "fourth," retained in the bureau on approval of the requisition, is destroyed when the receipted second has been received and filed.

A supply depot must have some authority and a system of accountability for making expenditures from their stock. The "first" of every approved requisition is, then, not only the authority for the issue of the stores enumerated thereon, but becomes, when receipted, a voucher in the supply depot's system of accounting for the expenditure of their stock.

Material and stores are procurable only on requisitions approved by competent authority, except where the bureau directs that requests shall be made by letter. The following articles, for example, must be requested by letter and not by requisition: Biological supplies, blood stains, culture tubes, X-ray films.

Open Purchase Requisitions.

Medicine and Surgery requisition Form 1 is used for all purchases of supplies and services on shore for the Medical Department of the Navy.

Supplies and Accounts requisition Form 44 is used by the Medical Department of the Navy for all purchases of supplies and services afloat.

Blank forms are used that indicate the information required concerning the necessity and character of and the quantity and estimated cost of the supplies or services to be purchased.

Each requisition is accompanied by as many memorandum copies as may be required. The estimated cost of each item and the total is entered upon the memorandum copies only. The original bears the necessary signatures, and, except in the cases of formal contracts, accompanies the original of the public bill, and finally lodges with the General Accounting Office of the Treasury, Military Division. One memorandum copy of the requisition remains in the Bureau of Medicine and Surgery, two in the Bureau of Supplies and Accounts, and one in the office of the purchasing pay officer.

Requisitions must give such accurate information as will enable the purchasing pay officers and the bidder to understand readily what is required, and its items must be arranged so that the articles of a similar nature may be grouped. Articles or services coming under different appropriations may not be combined on one requisition. Proprietary articles must not be called for when it can be avoided, but when called for, the officer making the requisition must certify that the "articles and no others will answer the necessities of the service."

A hospital corpsman preparing requisitions for open purchase should be familiar with section 3, chapter 43, Navy Regulations, and the instructions contained therein must be carefully followed.

Copies of all instructions issued from time to time by the Bureau of Supplies and Accounts relative to the preparation of open purchase requisitions should be filed, so that they may be available for reference.

Particular attention should be given the question of procuring materials under standard specifications, and requisitions should adhere to such specifications so far as is practicable.

Supplies from supply officers on stub requisitions.

Stub requisitions on a supply officer, ashore or afloat, are prepared by the head of the medical department on the prescribed forms (S. & A.) and do not require the approval of the Bureau of Medicine and Surgery, although funds must be allotted by the bureau prior to the preparation of the requisition. For this reason and the further fact that this arrangement is local, stub requisitions are not numbered in the regular series of the fiscal year. They are filed as vouchers when the transaction has been completed.

Whenever practicable, advantage should be taken of this means of securing needed supplies that are carried in stock by a supply officer. These supplies are purchased in large lots at a reduced cost; they are standard goods and their quality can be depended upon. Furthermore, this method of procurement is direct and so avoids the delay consequent upon the bureau's approval of a more formal requisition and the purchase and delivery of supplies thereunder.

Public bills.

When supplies purchased under an open-purchase requisition have been received and accepted, payment for them must be made.

Public bills are prepared on the appropriate blank forms. Medicine and Surgery bill Form 5 is used with requisition Form 1; Supplies and Accounts bill Form 51a is used with requisition Form 44. These blank forms have been submitted to the Comptroller of the Treasury, whose approval of same as to completeness is required by law before they may be used. An

original and a sufficient number of memorandum copies are required. The original, accompanied by the original of the requisition, finally lodges with the General Accounting Office of the Treasury, Military Division. One memorandum copy remains in the Bureau of Medicine and Surgery, two in the Bureau of Supplies and Accounts, one with the disbursing officer who makes the payment, one with the accounting officer of the navy yard, and one, stamped "Dealer's Copy," accompanies the check to the payee as an identification of the payment. The office in which the requisition and the public bill originate retains copies of each, which are recorded in the charge register. Signatures are affixed only on the original copy of a public bill. The memorandum copies are true copies, except that the places for signature are filled by stamping or typing therein the names.

As articles on a requisition may be procured from several dealers, two or more public bills may be necessary in connection with but one requisition. In such instances the original of the requisition accompanies the first public bill made, and notation of its disposition is appropriately made on all subsequent public bills under the requisition. This notation states the number, date, dealer's name, and amount of the voucher to which the original of the requisition is attached.

Medical officers are responsible for the correctness of the certificate of inspection and acceptance and the purchasing pay officers for the correctness of the certificate as to method of purchase and as to prices. It is required that both exercise special care not only as to the accuracy of the figures, but also that the appropriation involved shall be correctly stated in title and fiscal year.

The requisition and voucher forms have been carefully prepared to meet every legal requirement, and it is forbidden that the phraseology of the forms be altered when either supplies or services are furnished or performed.

Special exigency public bills.

Medicine and surgery bill Form 6 (on shore only). This voucher form is for use at hospitals and at shore stations in case of sudden emergency, such as broken wafer, steam or gas pipes; falling walls or ceilings; broken heating or cooking apparatus; and in all cases where the work must be done immediately; also for the purchase of articles not provided for on approved requisitions for the care and welfare of the sick which are needed immediately; and for funeral expenses. It shall never be used if time will permit the procurement of the articles or services on an approved requisition.

Special exigencies arise in the care of the sick and the preservation of hospital buildings when supplies or services can not be obtained under the authority of existing contracts or requisitions. In recognition of this fact and to provide for payment for such supplies or services by public bill without warrant of statute law, the Second Comptroller of the Treasury prepared the form of public bill known as "Special exigency public bill" for special use by the medical department of the Navy.

The exigency clause on Form 6 is filled out by the senior medical officer of the hospital or station, who assumes the entire responsibility for procuring the supplies and services paid for on special exigency vouchers. It then is forwarded to the Surgeon General for approval, and subsequently transmitted to the Bureau of Supplies and Accounts for the same action as prescribed for other public bills.

Special supplies and method of procural.

Typhoid prophylactic, vaccines, and serums are procurable upon application by letter or telegram to the nearest naval medical supply depot.

Blood stain (in sealed tubes containing 0.075 gm. and methyl alcohol 25 c. c.) is procurable upon application to the Naval Medical Supply Depots at Brooklyn, N. Y., and Mare Island, Calif.

Culture media is procurable upon application by letter or telegram to the Naval Medical Supply Depot, Brooklyn, N. Y.

Amboceptor paper, antigen, bacterial cultures, bacterial emulsions, mailing cases, bottles, and vials for the forwarding of samples or specimens are procurable upon application by letter or telegram to the Naval Medical School, Washington, D. C.

Alcohol is procured, by hospitals only, from the Supply Department ashore in quantities of not less than 5 gallons.

Transfer of labor from a navy yard is obtained by request on the Bureau of Medicine and Surgery, which allots the necessary funds and authorizes the commandant of the yard concerned to furnish the labor required.

To obtain supplies under Navy Pay Office contracts the senior medical officer makes order upon the contractor.

Articles supplied on annual contract of the Bureau of Yards and Docks.

When it becomes necessary to prepare a requisition at a naval hospital or shore station for furniture, etc., the contract schedule covering annual contracts entered into by the Bureau of Yards and Docks, a copy of which may be found in the office of the public works officer of the station, should be examined to ascertain whether the items supplied under the annual contract will fulfill requirements.

Articles desired under such contract should appear on a separate requisition prepared in the usual way on Form 1, and in making selections from the contract the following information should be given in every instance on the face of the requisition and in the order here indicated:

- (a) Item number of contract.
- (b) Name of article required.
- (c) Pattern number of article required.
- (d) Kind of wood of article required.
- (e) Upholstering number, when applicable.

This information is necessary to make clear to the Bureau of Yards and Docks what is desired when placing the order with the contractor.

The contractor is directed by the Bureau of Yards and Docks to ship the articles to the hospital or medical department of the station concerned. If inspection of the articles proves satisfactory, preparation of the necessary voucher or vouchers for the payment of the stores is made by the medical department in the prescribed bill form and in the usual way.

Departmental contracts.

When a formal departmental contract is entered into by the Government for material or services for the medical department of the Navy and the work is carried on under the supervision of the Bureau of Yards and Docks, vouchers for the payment of bills under the contract are prepared by the public works officer having direct supervision of the work, and copies of all vouchers to complete the files of the medical department of the station concerned should be procured from the office preparing the vouchers.

It is very important that a full set of vouchers for each contract be recorded and filed, so that a complete record of the cost, date of completion, etc., of the work will show in the accounting records.

ACCOUNTING AND PROPERTY ACCOUNTABILITY.

By the United States Navy Regulations officers are required to avoid any unnecessary expenditure of public money or stores, and so far as may be in their power prevent the same in others, and to attend to the care and preservation of all Government property in their charge.

An accurate account of all Government property under the cognizance of the medical department of the Navy must be kept, and an inventory, itemized for nonexpendable items and by classes for expendable items, made and forwarded to the Bureau of Medicine and Surgery on July 1 of each year.

Government property is of two classes—expendable and nonexpendable. Medicines, hospital stores, and certain surgical appliances, dressings, hospital and nursing appliances, etc., are classed as expendable property, and no itemized inventory is required by the bureau, but report of the value of the expendable property on hand must be made. Nonexpendable property is property that is not consumable; that is, not easily breakable (such as hospital furniture), or not readily made unfit for service by continued use (such as surgical instruments). Reference to the Supply Table of the medical department, United States Navy, should be made in determining to which class an article belongs.

Medical department property may be transferred, under certain conditions fully explained in section 4, chapter 20, Manual of the Medical Department, from one officer to another, to merchant ships in distress or foreign ships of war, from one ship in commission to another, and from a shore station to a ship or vice versa.

When nonexpendable property is lost or damaged so as to be unfit for further use, it shall be surveyed for the purpose of establishing and reporting the facts and making recommendations as to the disposal of the property. In the case of property lost, the responsibility for the loss shall be ascertained and report made thereon. In connection with surveys on property, reference should be made to section 5, chapter 20, Manual of the Medical Department, or to instructions issued by the Bureau of Medicine and Surgery.

That each commanding officer of a naval hospital may know at any time what has been expended or received, what the hospital is expending or receiving and will expend or receive and the reason therefor, and thereby enable the Bureau of Medicine and Surgery and the commanding officer to determine promptly the capital invested and the actual cost of maintenance and operation for any period of time is the principle on which the present system of naval hospital accounting is based.

A chief pharmacist or pharmacist known as the accounting and property officer is in charge of this department and is directly responsible for its proper functioning. The accounting and property officer definitely and permanently is assigned in the organization of a hospital. In addition to such other duties as may be assigned him, the duties of the accounting and property officer are summarized below.

(a) Acts as assistant to the commanding and executive officers in financial and property matters.

(b) Is accountable to the commanding and executive officers for all equipment and stores in his charge, exercising personal and careful supervision over their condition, and the economical expenditure thereof, reporting any deficiencies through the executive officer to the commanding officer.

(c) Prepares requisitions, public bills, invoices, requests for allotments, and all other forms and reports pertaining to financial matters.

(d) Under the direction of the commanding and executive officers, issues and accounts for all stores and equipment.

(e) Maintains the proper records of equipment issued to the several departments of the hospital, obtaining and retaining in file custody receipts therefor, reporting any deficiencies through the executive officer to the commanding officer.

(f) Submits through the executive officer to the commanding officer at the end of each month the Expense Analysis Statement, condition of allotments and requisitions, a statement as to the balances available or prospective obligations, if any, with the reasons therefor.

(g) Takes actual inventory of stores on hand at the end of each quarter, reporting in detail through the executive officer to the commanding officer any deficiencies in the amounts as shown on the books and as shown by actual inventory. The commanding officer's approval is his authority to adjust the books to conform to the inventory, such adjustments to be made in the books as described under inventory adjustments in the instructions concerning the accounting system.

(h) Upon detachment or relief makes a complete inventory of stores in company with his successor and effects a complete transfer to his successor, reporting the same to the commanding officer.

(i) Keeps himself informed of the laws, regulations, and instructions governing the submission of financial reports, etc.

The system is intended to be elastic so that it may suit the needs of all hospitals, regardless of size or number of departments into which the hospital may be divided, or the number of items issued or used by each department.

In order to economize, that is, to practice economies that are of definite value, it must be known just what is being done at the present time, how it is being done, how it compares with other naval hospitals, and the results obtained. If this is not known, any effort to economize is not based on sufficient knowledge to secure results.

The work of a hospital is so complicated, and requires so many departments and so many kinds of work, that even approximate figures for the cost of any given item or department can not be obtained without a system of accounting independent of cash transactions. This system is not simply a total of bills paid or vouchers passed but represents the value of supplies actually issued and wages actually earned, and separate appropriations and costs. To separate appropriations and costs the accounting system is divided into two parts:

(1) A record of expenditures made during a fiscal year that includes only actual expenditures from current appropriations.

(2) A cost accounting system that has no reference to actual cash expenditures from current appropriations except as they appear in the charge register (which takes the place of the former bill book) and shows the actual issues of supplies and of wages accrued during a certain period of time.

Owing to the complex transactions involved in the business of hospitals, double entry bookkeeping is the best method of recording them. The three principal reasons for this are: First, because of the element of time which enters into the transactions; second, because there are internal and external checks which guard against error and help to prevent fraud; and third, to obtain proper statements of operating cost. Double entry bookkeeping gives the assets and capital in full, together with gains or losses and their sources. Every transaction necessitates the debiting of one account and crediting of another.

Double entry bookkeeping is based on the theory of an accountability to capital which always exactly equals the amount of assets. After the initial balance or equilibrium is secured no change in the form of assets or capital, no additions to the fund nor subtractions from it, in fact, no business transaction whatsoever, can affect the theoretical balance thus obtained.

In the initial entry the equilibrium is brought into the books, that is the debit and credit side are in balance. In all subsequent entries, equal amounts likewise must be carried to the debit and credit columns. From this principle comes the double entry bookkeeping rule that for every debit there must be a corresponding credit.

The details of the proper accounts to be debited and credited are given in the instructions governing the use of this system issued by the Bureau of Medicine and Surgery.

The term capital, as used in this system, represents the money invested in the institution.

Two distinct elements are found in accounts during an accounting period, real and nominal elements.

Real elements consist primarily of asset values, but there has been included in the classification of real accounts the accounts that record capital. The books at the time of opening and after closing at the end of an accounting period (the fiscal year is considered as an accounting period) therefore contain real accounts only.

Nominal elements are statistical in their nature and record receipts and expenses in various classifications. The nominal elements are created as the accounting period progresses, and they are closed out at the end of the accounting period.

The following forms are provided for the operation of the cost-accounting system: Journal, charge register, expense-analysis register, expense-analysis statement, stock ledger, equipment ledger (present stock cards), commissary ledger (present ledger), general ledger, recapitulation of ledger accounts.

The journal.

The journal is one of the books of original entry and takes care of all items that can not be entered directly into the charge register, such as opening entry, transfer vouchers received and issued, surveys, inventory adjustments, contingencies and losses, summary entries at the end of the month, etc.

The charge register.

The charge register is the other book of original entry in which the voucher and its distribution is recorded. Every purchase transaction, whether of capital items of hospital property, supplies, or services of any kind, when received from a medical supply depot, supply department of the Navy, or paid for on public bill or pay roll, is entered in this register.

The expense-analysis register.

The expense-analysis register is an analysis of the expense incurred by each department in a hospital by classes of supplies.

The expense-analysis statement

This statement is a recapitulation of the expense-analysis register, and is arranged so that each month comparisons may be made with previous months.

The stock ledger.

The stock ledger is an itemized record of the receipt and expenditure of all expendable supplies.

The equipment ledger.

The equipment ledger is an itemized record of the receipt and expenditure of all nonexpendable articles of equipment.

The commissary ledger.

The commissary ledger is an itemized record of the accounts of the commissary department, both as to quantity and cash value of stores.

The general ledger.

The general ledger, containing 13 accounts that are practically controlling accounts, is designed to show the summary of all hospital expenses as sub-classified and distributed in the expense-analysis register.

The accounting system used for other shore stations and for vessels afloat is much simpler, and does not require any detailed explanation here other than that it is based on the same principles as the system for naval hospitals.

OTHER REPORTS AND RETURNS.

In transacting the business of the Medical Department of the Navy many reports and returns other than those described above are required. These are lettered forms, hospital forms, Hospital Corps forms, and miscellaneous forms. General and detailed instruction concerning their preparation and use is given in chapters 23 and 24, Manual of the Medical Department and changes therein, and in Bureau of Medicine and Surgery circular letters.

Identification records.

While not Bureau of Medicine and Surgery forms, hospital corpsmen are concerned in the preparation of identification records, which consist of the finger prints and personal description in the case of every man enlisting in the Navy and Marine Corps. They are forwarded to the Bureau of Navigation and to the Major General Commandant respectively. The finger print and identification record is not required upon reenlistment or upon discharge for undesirability. The form adopted for the recording of finger prints and personal description (Form N. Nav. 2 for naval personnel and Form N. M. C. 330 for marines) carries the finger-print record on one side and the personal description on the other.

In addition to the above records for identification, hospital corpsmen frequently are required to prepare identification tags, which are made of monel metal and worn by all persons in the naval service, in time of war or other emergency, suspended around the neck.

Paragraphs 1488 to 1499, chapter 11, of the Manual of the Medical Department, and articles D-1000 to 1131, Bureau of Navigation Manual, contain detailed information concerning the preparation and use of these records.

HOSPITAL CORPS FORMS.

A short description of the various Hospital Corps forms is given to show their purpose. These forms are identified by the letters N. M. S. H. C. and the number appearing on each. If the words which these letters indicate were written in full they would be Navy, Medicine and Surgery, Hospital Corps.

Form.	Name.	Use.
N. M. S. H. C. 1....	Examination report.....	To enable the Bureau of Medicine and Surgery to judge of the fitness of hospital corpsmen for advancement in rating and have a permanent record of such examinations.
N. M. S. H. C. 2....	Qualification report (enlisted personnel).	To enable the Bureau of Medicine and Surgery to have information of the duties performed by hospital corpsmen and the duties for which they are especially qualified by training and experience.
N. M. S. H. C. 2 (pink).	Qualification report (chief pharmacists and pharmacists).	To enable the Bureau of Medicine and Surgery to have information of the duties performed by chief pharmacists and pharmacists and the duties for which they are especially qualified by training and experience.
N. M. S. H. C. 3....	Transfer and disposition card.	To enable the Bureau of Medicine and Surgery to have notice of any change of status or station of all members of the Hospital Corps when occurring and thereby keep accurate individual records of them.
N. M. S. H. C. 4....	Roster report of the Hospital Corps.	To enable the Bureau of Medicine and Surgery to have full and complete information as to present station, status, and duties being performed in the case of all hospital corpsmen, and a means to check information received on Form N. M. S. H. C. 3 as to accuracy.
N. M. S. H. C. 5....	Statement of qualifications for chief pharmacist's mate and pharmacist's mate, first class.	To enable the Bureau of Medicine and Surgery to have special information regarding the qualifications of hospital corpsmen for advancement to these ratings
N. M. S. H. C. 6....	Report of examination for pharmacist (provisional), Naval Reserve Force.	To enable the Bureau of Medicine and Surgery to have permanent records of qualifications of pharmacists, Naval Reserve Force.
N. M. S. H. C. 7....	Certificate of graduation, Hospital Corps Training School.	To enable men completing course of instruction to have certificate showing completion of course and graduation, and the Bureau of Medicine and Surgery to have a permanent record of men graduating, with the average percentage attained during the course.
N. M. S. H. C. 7a....	Certificate of graduation, Pharmacist's Mates School.	To enable men completing advanced course of instruction to have certificate showing completion of course and graduation, and the Bureau of Medicine and Surgery to have a permanent record of men graduating, with the average percentage attained during the course.

The following tabulation shows the various forms which members of the Hospital Corps may be required to prepare, when they must be made out, and when forwarded. Whenever any doubt exists concerning the use of a form reference should be made to the Navy Regulations, the manuals of the various bureaus, and circular letters or other instructions issued to the service from time to time. It should be remembered that while the forms listed are required at present, changes frequently occur in those necessary to be submitted, with the result that additions or deletions in this table may have to be made.

1. ARRIVAL, DUTY, NAVY:

- Endorse orders and return.
- Entry on pay account.
- Entry Journal of the Medical Department.
- Entry muster card.
- Entry in health record.
- Entry N. M. S. H. C. 4.
- Entry on morning report.
- Make N. M. S. H. C. 3.
- Make N. Nav. 48 and 48a.
- Make jacket.

PAPERS TO ACCOMPANY—

- Enlistment record.
- Health record.
- Pay accounts.
- C. S. C., if any.

2. ARRIVAL, PATIENT, NAVY:

- Entry Journal of the Medical Department.
- Entry hospital register.
- Entry on pay account.
- Entry muster card.

2. ARRIVAL, PATIENT, NAVY—Continued.

Entry on morning report.
Entry Form I (rough).
Entry health record.
Entry N. M. S. H. C. 4, if hospital corpsman.
Make jacket.
Make N. M. S. H. C. 3, if hospital corpsman.
Make Form F.
Make N. Nav. 48 and 48a.
Make N. Nav. 29.
Make misconduct report if necessary.

PAPERS TO ACCOMPANY—

Enlistment record.
Health record.
Pay accounts.
C. S. C., if any.
Gunnery record, if any.
Hospital ticket.

3. ARRIVAL, PATIENT, MARINE:

Entry Journal of the Medical Department.
Entry hospital register.
Entry health record.
Entry on morning report.
Entry on muster card.
Entry Form I (rough).
Make Form F.
Make jacket.
Make misconduct report if necessary.

PAPERS TO ACCOMPANY—

Health record.
Hospital ticket.
Conduct report.

4. ARRIVAL, OFFICER, DUTY:

Endorse orders and return. Make the required number of copies.
Entry in health record.
Entry Journal of the Medical Department.
Entry on morning report.
Entry on N. M. S. H. C. 4 if Chief Pharmacist or Pharmacist.
Make jacket.
Make muster card.
Make N. Nav. 64.
Make N. M. S. H. C. 3 if Chief Pharmacist or Pharmacist.
Make request for quarters to commanding officer.
File health record. If not with officer, write for same.

5. ARRIVAL, OFFICER, PATIENT, NAVY:

Endorse orders, if any.
Entry on morning report.
Entry Journal of the Medical Department.
Entry hospital register.
Entry Form I (rough).
Entry health record.
Entry on N. M. S. H. C. 4 if chief pharmacist or pharmacist.
Make jacket.
Make muster card.
Make Form F.
Make N. M. S. H. F. 1.
Make N. M. S. H. C. 3 if chief pharmacist or pharmacist.
Make misconduct report if necessary.
Make Form S and send to supply officer.

PAPERS TO ACCOMPANY—

Health record.
Hospital ticket.

6. ARRIVAL, OFFICER, PATIENT, MARINE:

Endorse orders, if any.
Entry on morning report.
Entry Journal of the Medical Department.
Entry hospital register.

6. ARRIVAL, OFFICER, PATIENT, MARINE—Continued.

Entry Form I (rough).

Entry health record.

Make jacket.

Make muster card.

Make Form F.

Make N. M. S. H. F. 1 (1 copy to Headquarters, U. S. M. C.).

Make misconduct report if necessary.

Make Form S and send to supply officer or Marine paymaster having accounts.

PAPERS TO ACCOMPANY—

Health record.

Hospital ticket.

7. ARRIVAL, NURSE, DUTY:

Endorse orders.

Entry Journal of the Medical Department.

Entry memorandum for monthly return.

Chief nurse forwards information slip.

Copy of orders to supply officer.

Make S. & A. 56.

PAPERS TO ACCOMPANY—

Health record. If not with nurse, write for same.

8. ARRIVAL, NURSE, PATIENT:

Entry Journal of the Medical Department.

Entry hospital register.

Entry Form I (rough).

Entry health record.

Entry memorandum for monthly return.

Make muster card.

Make Form F.

Make Form S and send to supply officer.

Chief nurse forwards information slip.

PAPERS TO ACCOMPANY—

Health record.

Hospital ticket.

9. ARRIVAL, SUPERNUMERARY, PATIENT:

Letter to M. and S. admission of supernumerary, giving name in full, date, and place of birth.

Entry Journal of the Medical Department.

Entry on morning report.

Entry hospital register.

Entry Form I (rough).

Make jacket.

Make muster card.

Make medical history sheet giving name in full, date and place of birth.

Make Form F.

Make Form S and send to supply officer in the case of retired officer and enlisted men of the Navy and Marine Corps, and in the case of civilian employees.

Make N. M. S. H. F. 1 in the case of retired officer.

Notify the governor of Naval Home, Philadelphia, Pa., in the case of a beneficiary.

Notify the Honorable Commissioner of Pensions, Pension Office, Washington, D. C., in case of admission of pensioner patient, giving full name, rate, and pension number.

Make Form 52 in the case of U. S. Army patient.

10. DEPARTURE, OFFICER, DUTY:

Endorse orders and make necessary copies.

Entry Journal of the Medical Department.

Entry on morning report.

Entry on N. M. S. H. C. 4 in the case of chief pharmacist or pharmacist.

Close health record.

Close jacket.

Close muster card.

Make fitness report.

Make N. M. S. H. C. 2 in case of a chief pharmacist or pharmacist.

Make N. M. S. H. C. 3 in case of a chief pharmacist or pharmacist.

Make N. Nav. 64.

Make S. & A. 34 and 34a.

11. DEPARTURE, NAVY, DUTY :

Entry Journal of the Medical Department.
Entry on morning report.
Entry muster card.
Issue orders.
Close health record.
Close enlistment record.
Close C. S. C., if any.
Close jacket.
Make N. M. S. H. F. 3.
Make N. M. S. H. F. 4.
Make N. M. S. H. F. 5.
Make N. M. S. H. F. 7.
Make N. M. S. H. C. 2.
Make N. M. S. H. C. 3.
Make entry on N. M. S. H. C. 4.
Make N. Nav. 8 and 8a.
Make S. & A. 34 and 34a if necessary.

12. DEPARTURE, NURSE, DUTY :

Endorse orders and make necessary copies.
Entry Journal of the Medical Department.
Entry memo. for monthly return.
Close health record.
Make S. & A. 34 and 34a.
Chief nurse sends information slip.

13. DEPARTURE, OFFICER, PATIENT, NAVY :

Endorse orders, if any.
Entry Journal of the Medical Department.
Entry on morning report.
Entry hospital register.
Entry Form I (rough).
Close muster card.
Close health record.
Close Form F.
Close jacket.
Make N. M. S. H. F. 2.
Make misconduct report if necessary.
Make Form T and send to supply officer.
Make N. M. S. H. C. 2 if chief pharmacist or pharmacist.
Make N. M. S. H. C. 3 if chief pharmacist or pharmacist.
Make entry on N. M. S. H. C. 4 if chief pharmacist or pharmacist.
Make N. Nav. 64.
Make S. & A. 34 and 34a if necessary.

14. DEPARTURE, OFFICER, PATIENT, MARINE :

Endorse orders if any.
Entry Journal of the Medical Department.
Entry on morning report.
Entry hospital register.
Entry Form I (rough).
Close muster card.
Close health record.
Close Form F card.
Close jacket.
Make N. M. S. H. F. 2 (1 copy to Headquarters, U. S. M. C.).
Make misconduct report if necessary.
Make Form T and send to supply officer or Marine paymaster having accounts.
Transportation of household goods made by Quartermaster, U. S. M. C.

15. DEPARTURE, NAVY, PATIENT :

Entry Journal of the Medical Department.
Entry on morning report.
Entry hospital register.
Entry Form I (rough).
Close health record.
Close jacket.
Close Form F.
Close enlistment record.

15. DEPARTURE, NAVY, PATIENT—Continued.

- Close C. S. C. if any.
- Close muster card.
- Close gunnery record if any.
- Make N. M. S. H. C. 2 if hospital corpsman.
- Make N. M. S. H. C. 3 if hospital corpsman.
- Make entry on N. M. S. H. C. 4 if hospital corpsman.
- Make N. M. S. H. F. 3.
- Make N. M. S. H. F. 4.
- Make N. M. S. H. F. 5.
- Make N. M. S. H. F. 7.
- Make misconduct report if necessary.
- Make N. Nav. 8 and 8a.
- Make S. & A. 34 and 34a if necessary.

16. DEPARTURE, MARINE, PATIENT:

- Entry Journal of the Medical Department.
- Entry on morning report.
- Entry hospital register.
- Entry Form I (rough).
- Close health record.
- Close muster card.
- Close Form F.
- Close jacket.
- Make misconduct report if necessary.
- Transportation of household goods made by Quartermaster, U. S. M. C.

17. DEPARTURE, NURSE, PATIENT:

- Entry Journal of the Medical Department.
- Entry on morning report.
- Entry hospital register.
- Entry Form I (rough).
- Entry memoranda monthly return.
- Close health record.
- Close Form F.
- Make Form T and send to supply officer.
- Make S. & A. 34 and 34a if necessary.
- Chief nurse sends information slip.

18. DEPARTURE, SUPERNUMERARY, PATIENT:

- Letter to Bureau of Medicine and Surgery giving full name with date and place of birth.
- Entry Journal of the Medical Department.
- Entry on morning report.
- Entry in hospital register.
- Entry Form I (rough).
- Close medical history sheet and forward to Bureau of Medicine and Surgery.
- Close muster card.
- Close Form F. (Do not forward to Bureau of Medicine and Surgery.)
- Close jacket.
- Make Form T and send to supply officer in the case of retired officer and enlisted men of the U. S. Navy and Marine Corps and in the case of civilian employees.
- Make N. M. S. H. F. 2 in the case of retired officers. Notify the Governor of Naval Home, Philadelphia, Pa., in the case of a beneficiary.
- Notify the Honorable Commissioner of Pensions, Pension Office, Washington, D. C., in case of a pensioner, giving full name, rate, and pension number.
- Make Form 52 in case of U. S. Army patient.

19. DEATH, OFFICER, NAVY OR MARINE CORPS:

- Entry Journal of the Medical Department.
- Entry on morning report.
- Entry hospital register.
- Entry Form I (rough).
- Entry autopsy book.
- Entry burial record.
- Close health record.
- Close jacket.
- Close Form F. See that diagnosis agrees with primary cause on Form N.
- Make Form T and send to supply officer or Marine paymaster having accounts.

19. DEATH, OFFICER, NAVY OR MARINE CORPS—Continued.

Make city or county death report.

Make N. M. S. H. F. 61.

Make N. M. S. H. C. 2 if Chief Pharmacist or Pharmacist.

Make N. M. S. H. C. 3 if Chief Pharmacist or Pharmacist.

Make entry on N. M. S. H. C. 4 if Chief Pharmacist or Pharmacist.

Make Form N.

Make S. and A. 34 and 34a, if necessary. Quartermaster, U. S. M. C. will ship household effects in case of Marine Corps officer.

Make inventory of effects.

Make N. Nav. 64 (Navy officer).

Despatch to next of kin, Secretary of the Navy, and Bureau of Medicine and Surgery. Despatch to Headquarters, U. S. M. C. in case of Marine Corps officer.

Notify commandant in the case of Navy officer and commanding officer, Marine Barracks, in the case of marine officer. (See chap. 19, Manual of the Medical Department.)

20. DEATH, NAVY:

Entry Journal of the Medical Department.

Entry on morning report.

Entry hospital register.

Entry Form I (rough).

Entry autopsy book.

Entry burial record.

Entry muster card.

Close health record.

Close jacket.

Close Form F. See that diagnosis agrees with primary cause of death on Form N.

Close enlistment record.

Close C. S. C., if any.

Close gunnery record, if any.

Make N. M. S. H. C. 2 if hospital corpsman.

Make N. M. S. H. C. 3 if hospital corpsman.

Make entry on N. M. S. H. C. 4 if hospital corpsman.

Make N. M. S. H. F. 61.

Make S. and A. 35d.

Make entry on S. and A. 35.

Make Form N.

Make city or county death report.

Make N. Nav. 48 and 48a.

Make S. & A. 34 and 34a, if necessary.

Make S. & A. 330, if necessary.

Despatch to next of kin, Secretary of the Navy, and Bureau of Medicine and Surgery. Notify commandant. (See chap. 19, Manual of the Medical Department.)

21. DEATH, MARINE:

Entry Journal of the Medical Department.

Entry on morning report.

Entry hospital register.

Entry Form I (rough).

Entry autopsy book.

Entry burial record.

Close health record.

Close jacket.

Close Form F. See that diagnosis agrees with primary cause on Form N.

Make city or county death report.

Make Form N.

Make inventory of effects and receipt.

Make N. M. S. H. F. 61.

Despatch to headquarters, U. S. M. C., next of kin, Secretary of the Navy, and Bureau of Medicine and Surgery. (See chap. 19, Manual of the Medical Department.)

Notify commanding officer, Marine Barracks.

Have Quartermaster, U. S. M. C., ship household effects if necessary.

22. DEATH, NURSE CORPS:

Entry journal of the Medical Department.

Entry on morning report.

Entry hospital register.

22. DEATH, NURSE CORPS—Continued.

Entry Form I (rough).

Entry autopsy book.

Entry burial record.

Close health record.

Close Form F. See that diagnosis agrees with primary cause on Form N.

Make memorandum for monthly return.

Make Form T and send to supply officer.

Make N. M. S. H. F. 61.

Make S. & A. 34 and 34a if necessary.

Make inventory of effects and receipt.

Make city or county death report.

Make Form N.

Despatch to next of kin, Secretary of the Navy and Bureau of Medicine and Surgery.

Notify supply officer having accounts.

23. DEATH, SUPERNUMERARY:

Entry Journal of the Medical Department.

Entry on morning report.

Entry hospital register.

Entry Form I (rough).

Entry autopsy book.

Entry burial record.

Close medical history sheet and forward to Bureau of Medicine and Surgery.

Close jacket.

Close Form F. (Do not send to Bureau of Medicine and Surgery.)

Close muster card.

Close Form 52 in the case of U. S. Army patient and forward to Bureau of Medicine and Surgery.

Make Form N.

Make city or county death report.

Make inventory of effects and receipt.

Make Auditor's Expense Claim in the case of retired and enlisted men of the U. S. Navy and Marine Corps.

Make Form T and send to supply officer in case of retired officer and enlisted men of the U. S. Navy and Marine Corps and civilian employees.

Make N. M. S. H. F. 61.

Despatch to next of kin, Secretary of the Navy and Bureau of Medicine and Surgery, and Headquarters, U. S. M. C., in the case of Marine Corps personnel. (See chap. 19, Manual of the Medical Department.)

Notify Commandant in case of Navy personnel, and commanding officer, Marine Barracks, in the case of Marine Corps personnel.

Notify the Governor, Naval Home, Philadelphia, Pa., in the case of a beneficiary.

Notify the Honorable Commissioner of Pensions, Pension Office, Washington, D. C., in the case of a pensioner.

Notify Army Post having records in the case of a U. S. Army patient.

24. DESERTION:

Entry Journal of the Medical Department.

Entry on morning report.

Entry hospital register, if patient.

Entry muster card.

Entry on N. M. S. H. C. 4 if hospital corpsman.

Entry Form I (rough) if a patient.

Close health record.

Close packet.

Close service record.

Close C. S. C., if any.

Close Form F, if a patient.

Make N. M. S. H. C. 2 if hospital corpsman.

Make N. M. S. H. C. 3 if hospital corpsman.

Make N. Nav. 48 and 48a, 65 and 67.

Make S. & A. 35c and 330.

Make entry on S. & A. 35.

Make descriptive list and send to all receiving ships.

If a marine, discharge to duty and he will be declared a deserter from the marine barracks.

If a marine, make inventory of effects and forward to the marine barracks.

Inform Bureau of Navigation of desertion by letter.

25. DESERTER, REPORTING ON BOARD :

- Make N. Nav. 7.
- Make N. Nav. 66.
- Make N. Nav. 48 and 48a.
- Make S. & A. 35h.
- Make entry on S. & A. 35.
- Make N. M. S. H. C. 3 if hospital corpsman.
- Make entry on N. M. S. H. C. 4 if hospital corpsman.
- Make request to Bureau of Medicine and Surgery for health record.
- If a patient, make necessary hospital forms as required for a new arrival.

26. DISCHARGE, EXPIRATION OF ENLISTMENT, NAVY :

- Entry Journal of the Medical Department.
- Entry on morning report.
- Entry hospital register, if a patient.
- Entry muster card.
- Entry Form I (rough) if a patient.
- Close health record.
- Close jacket.
- Close service record.
- Close C. S. C., if any.
- Make Form F, if a patient.
- Make discharge if no C. S. C.
- Make N. Nav. 62 if necessary.
- Make S. & A. 35d.
- Make entry on S. & A. 35.
- Make N. Nav. 48 and 48a.
- Make N. M. S. H. C. 2 if hospital corpsman.
- Make N. M. S. H. C. 3 if hospital corpsman.
- Make entry on N. M. S. H. C. 4 if hospital corpsman.

27. DISCHARGE, EXPIRATION OF ENLISTMENT, MARINE :

- Entry Journal of the Medical Department.
- Entry hospital register.
- Entry Form I (rough).
- Close health record.
- Close Form F.
- Send to marine barracks for discharge.

28. DISCHARGE, RETIREMENT, NAVY :

- Entry Journal of the Medical Department.
- Entry on morning report.
- Entry hospital register, if a patient.
- Entry Form I (rough).
- Close health record.
- Close Form F, if a patient.
- Close service record.
- Close gunnery record, if any.
- Close C. S. C.
- Close muster card.
- Close jacket.
- Make S. & A. 35d.
- Make entry on S. & A. 35.
- Make S. & A. 34 and 34a if necessary.
- Make N. Nav. 48 and 48a.
- Make N. M. S. H. C. 2 if hospital corpsman.
- Make N. M. S. H. C. 3 if hospital corpsman.
- Make entry on N. M. S. H. C. 4 if hospital corpsman.
- Make N. M. S. H. F. 4.
- Endorse orders.

29. DISCHARGE, SENTENCE OF SUMMARY COURT-MARTIAL :

- Entry Journal of the Medical Department.
- Entry on morning report.
- Entry hospital register, if a patient.
- Entry Form I, if a patient.
- Close health record.
- Close service record.
- Close C. S. C., if any.

29. DISCHARGE, SENTENCE OF SUMMARY COURT-MARTIAL—Continued.

Close muster card.
Close Form F, if a patient.
Close jacket.
Make S. & A. 35d.
Make entry on S. & A. 35.
Make discharge if no C. S. C.
Make N. Nav. 48 ad 48a.
Make N. M. S. H. C. 2 if hospital corpsman.
Make N. M. S. H. C. 3 if hospital corpsman.
Make entry on N. M. S. H. C. 4 if hospital corpsman.

30. DISCHARGE, SENTENCE OF SUMMARY COURT-MARTIAL, MARINE PATIENT:

Entry Journal of the Medical Department.
Entry on morning report.
Entry hospital register.
Entry Form I (rough).
Close muster card.
Close health record.
Close Form F.
Close jacket.
Send to marine barracks for discharge.

31. DISCHARGE, NAVY PATIENT, MEDICAL SURVEY (I. S.):

Entry Journal of the Medical Department.
Entry on morning report.
Entry hospital register.
Entry Form I (rough).
Close health record.
Close service record.
Close C. S. C., if any.
Close muster card.
Close gunnery record, if any.
Close Form F. See that diagnosis agrees with that for which surveyed.
Close jacket.
Make S. & A. 35d.
Make entry on S. & A. 35.
Make N. Nav. 48 and 48a.
Make discharge if no C. S. C.
Make war service certificate if necessary.
Make N. M. S. H. C. 2 if hospital corpsman.
Make N. M. S. H. C. 3 if hospital corpsman.
Make entry on N. M. S. H. C. 4 if hospital corpsman.
Endorse report of survey.
Transportation to home, not to place of enlistment.

32. DISCHARGE, MARINE PATIENT, MEDICAL SURVEY (I. S.):

Entry Journal of the Medical Department.
Entry on morning report.
Entry hospital register.
Entry Form I (rough).
Close health record.
Close Form F. See that diagnosis agrees with that for which surveyed.
Close jacket.
Endorse report of survey.
Transfer to marine barracks for discharge.

33. DISCHARGE, OFFICER, MEDICAL SURVEY (I. S.):

Entry Journal of the Medical Department.
Entry on morning report.
Entry hospital register.
Entry Form I (rough).
Close muster card.
Close health record.
Close Form F. See that diagnosis agrees with that for which surveyed.
Close jacket.
Make N. M. S. H. C. 2 if chief pharmacist or pharmacist.
Make N. M. S. H. C. 3 if chief pharmacist or pharmacist.
Make entry on N. M. S. H. C. 4 if chief pharmacist or pharmacist.

33. DISCHARGE, OFFICER, MEDICAL SURVEY (I. S.)—Continued.
 Make Form T and send to supply officer.
 If ordered before a retiring board, transfer there with a "T" and upon return "RA" and when actually discharged give "I. S."
 Endorse retirement orders.
34. ENLISTMENT, EXTENSION OF, OR REENLISTMENT:
 Make N. Nav. 351 (shipping articles).
 Make N. Nav. 15 (consent of parents) if necessary.
 Make N. Nav. 54 (rejection) if necessary.
 Make N. Nav. 7 (description slip).
 Make N. Nav. 2 (finger print record).
 Make N. Nav. 48 and 48a.
 Make N. Nav. 323 if extension.
 Make health record if necessary.
 Make Form X.
 Make N. M. S. H. C. 3 if hospital corpsman.
 Make entry on N. M. S. H. C. 4 if hospital corpsman.
 Make S. & A. 35 I.
 Make entry on S. & A. 35.
 Send N. Nav. 6 to Bureau of Navigation if reenlistment.
35. LEAVE, NAVY:
 Entry Journal of the Medical Department.
 Entry service record.
 Entry muster card.
 Make leave papers.
 Make N. M. S. H. C. 3 if hospital corpsman.
 Make entry on N. M. S. H. C. 4 if hospital corpsman.
 Make S. & A. 35d for men who draw subsistence.
 Make entry on S. & A. 35.
 Patients should be discharged to duty when granted leave.
36. LEAVE, MARINE, PATIENT:
 See No. 35, delete service record.
37. LEAVE, NURSE:
 Make request to Bureau of Medicine and Surgery for over ten days.
 Entry Journal of the Medical Department.
 Entry rough record of nurse.
 If sick leave, proceed as in No. 17.
38. LEAVE, ABSENCE WITHOUT, NAVY:
 Entry Journal of the Medical Department.
 Entry on morning report.
 Entry service record.
 Entry muster card.
 Make N. M. S. H. C. 3 if hospital corpsman.
 Make entry on N. M. S. H. C. 4 if hospital corpsman.
 Make S. & A. 35e.
 Make entry on S. & A. 35.
39. LEAVE, ABSENCE WITHOUT, MARINE, PATIENT:
 Entry Journal of the Medical Department.
 Entry on morning report.
 Notify marine barracks.
 Absence over ten days return to barracks with a "D." (He will be declared a deserter by officials at the barracks.)
40. LEAVE, ABSENCE WITHOUT, SUPERNUMERARY:
 Entry Journal of the Medical Department.
 Entry on morning report.
 Entry hospital register.
 Discharge as "D."
 Notify Governor, Naval Home, Philadelphia, Pa., if a beneficiary.
41. LEAVE, OFFICER:
 Request leave from Bureau of Navigation if over ten days and travel time.
 Entry Journal of the Medical Department.
 Make Form F, if a patient ("T" to sick leave).
 Make report of leave of absence, Form N. Nav. 296, upon return.

42. TRANSFER, PATIENT, TO FITZSIMONS GENERAL HOSPITAL:

See Nos. 13, 14, 15, 16, 17, and 18; in addition, to be surveyed with a view of transfer to Fitzsimons General Hospital. Inform the commanding officer by timely despatch when transfers are to be made, giving names, ranks, or rates, stretcher case or not, date and hour of departure, route and probable date of arrival at Denver, Colo.

43. TRANSFER, OFFICER, NAVY, HOSPITAL FOR THE INSANE:

See No. 10, and in addition,
Make Department of the Interior form.
Endorse report of survey.
Make hospital ticket.
Make copy of report of survey for the Hospital for the Insane.
Order for admission furnished by Bureau of Medicine and Surgery.
Letter to next of kin.

44. TRANSFER, OFFICER, MARINE, HOSPITAL FOR THE INSANE:

See Nos. 14 and 43.

45. TRANSFER, NAVY ENLISTED, HOSPITAL FOR THE INSANE:

See Nos. 11 and 43.

46. TRANSFER, MARINE ENLISTED, HOSPITAL FOR THE INSANE:

See Nos. 16 and 43.

47. TRANSFER, SUPERNUMERARY, HOSPITAL FOR THE INSANE:

See Nos. 18 and 43.

48. RATING, RECOMMENDING FOR ADVANCEMENT IN; other than Chief Pharmacist's Mate and Pharmacist's Mate, first class:

Make N. M. S. H. C. 1 to be signed by all members of the board.

49. RATING, RECOMMENDING ADVANCEMENT IN; Chief Pharmacist's Mate and Pharmacist's Mate, first class:

Make N. M. S. H. C. 1.

Make N. M. S. H. C. 5.

Make N. Nav. 21.

Make N. Nav. 524.

All questions and answers to the Bureau of Medicine and Surgery.

50. RATING, ADVANCEMENT IN, HOSPITAL CORPS:

Make N. M. S. H. C. 3.

Make entry on N. M. S. H. C. 4.

Make entry on muster card.

Make entry on health record.

Make entry in service record.

Make N. Nav. 48 and 48a.

Make S. & A. 35a.

Make entry on S. & A. 35.

51. RATING, REDUCTION IN:

Make N. M. S. H. C. 3 if hospital corpsman.

Make entry on N. M. S. H. C. 4 if hospital corpsman.

Make entry in service record.

Make entry on health record.

Make entry on muster card.

Make N. Nav. 48 and 48a.

Make S. & A. 35a.

Make entry on S. & A. 35.

52. EMPLOYEES, MISCELLANEOUS, RULES AND REGULATIONS:

See sec. 10, Manual of the Medical Department.

Pay roll submitted on the 1st. and 16th. of each month.

53. REQUISITIONS, HEADSTONES:

Made in duplicate on forms provided on July 1st.

54. VACCINES, SERUMS, AND BACTERIOLOGICAL SUPPLIES:

From naval medical supply depots by letter or telegram.

55. SHIPMENT OF REMAINS:

Obtain transit permit and transit label from health authorities.

Make Government bill of lading (N. M. S. H. F. 60).

1 copy to consignee.

2 copies for express company at place of shipment.

1 copy for express company at place of arrival.

1 copy for hospital files with cost.

1 copy to be securely pasted on top of shipping casket and covered by shellac or varnish.

55. SHIPMENT OF REMAINS—Continued.

Special label prohibiting collection of express charges from consignee obtained from the express agent and attached to outside case.

Entry Journal of the Medical Department.

56. TELEGRAMS :

Make out in triplicate (N. M. S. H. F. 31 and 51).

Original sent to telegraph office.

Green copy filed.

Yellow copy mailed to addressee in case of being sent to a Government office.

Originals to be attached to monthly bill of telegraph company.

Telegrams to be numbered as follows: Message preceded by hospital number followed by 2 figures showing day of month; viz.: 76 (hospital No.) 03, (third day of month). Message signed by the hours 1 to 23 and the minutes 1 to 59 as follows: 1:15 p. m. will be written 1315, 1:15 a. m. will be written 0115.

57. RETURNS, DAILY :

Admission and discharge memorandum.

Form F cards of patients disposed of in any manner.

Liberty list.

Ration memorandum.

Receipt and expenditure vouchers.

58. RETURNS, WEEKLY :

Communicable diseases, letter from shore stations, telegram from certain stations.

N. M. S. H. C. 4, from certain stations.

Form I.

59. RETURNS ON THE 15TH OF EACH MONTH :

N. Nav. 25.

60. RETURNS ON THE 1ST AND 16TH OF EACH MONTH :

Pay roll, civilian.

61. RETURNS ON THE 28TH. OF EACH MONTH :

List of marines recommended for pay.

62. RETURNS ON THE LAST DAY OF EACH MONTH :

N. Nav. 25.

N. Nav. 37.

Letter to Bureau of Navigation showing the number of men furnished subsistence allowance.

Form F.

Form K-dental.

N. M. S. H. C. 4 (roster report).

N. M. S. H. F. 36 (ration memorandum).

N. M. S. H. F. 49.

Sanitary report.

Report of nurses.

Efficiency report (nurses).

Nurses' monthly returns.

Communicable diseases.

Summary of stub requisitions, S. & A. 178.

Pay-roll summary.

Report of expenditures.

The recapitulation.

63. RETURNS, QUARTERLY :

Letter to Bureau of Navigation, roster of enlisted men aboard.

Mark service records.

Labor roll summary.

N. M. S. H. F. 56.

Nurses' efficiency report.

64. RETURNS, SEMIANNUAL :

Forms B and Ba, and B-dental (Mar. 1 and Sept 1 from hospitals).

Report of fitness of officers (Apr. 1 and Oct. 1).

Efficiency list of employees.

Requisition for mess gear (June 30 and Dec. 31).

65. RETURNS, ANNUAL :

Form P. (Dec. 31.)

Form X. (Dec. 31.)

65. RETURNS, ANNUAL—Continued.

- Sanitary report. (See sec. 5, chap. 17, Manual of the Medical Department.)
- Forms D and Da. (July 1.)
- List of unmarked graves. (June 30.)
- Labor-saving devices. (June 30.)
- Report of physical examination of officers. (January.)
- Health record sheets of officers. (Jan 1.)
- Close all Form F cards as continued to next year. (Dec. 31.)
- Make new Form F cards. (Jan. 1.)
- Estimate of expenditures, letter. (Mar. 15.)
- Request for allotments.

66. WHEN NECESSARY:

- N. Nav. 17b.
- N. Nav. 443, Report of fitness of officers; upon detachment of officers or commanding officer.
- N. Nav. 521, beneficiary slip.
- N. M. S. H. C. 2.
- N. M. H. C. 3.
- N. M. S. O and 41.
- N. M. S. Ca and Ca-1.
- N. M. S. D and Da.
- N. M. S. L.
- N. M. S. M.
- N. M. S. 1, 1a, 4, and 4a.
- N. M. S. 5 and 5a.
- N. M. S. H. F. 45 and 54.
- N. M. S. B, Ba, and B-dental.
- N. M. S. Sp. and Spa.
- Report of epidemics.
- Journal of the Medical Department.
- S. & A. 44.
- S. & A. 51a.

REFERENCES.

- Handy Book for the Hospital Corps, 1917.
- U. S. Navy Regulations.
- Manual of the Medical Department.
- Bureau of Navigation Manual.

Commissary Department at Naval Hospitals.¹

The commissary department of naval hospitals is under the direct supervision of the commissary officer, who is a chief pharmacist or pharmacist assigned to this duty by the commanding officer. The commissary officer is directly responsible to the executive officer for the proper administration of the commissary department. A sufficient number of hospital corpsmen are assigned to this department to assist in carrying on the work. The personnel of the department includes the commissary officer, hospital corpsmen, and such ratings of civilian employees as may be necessary and are allowed as a complement by the Bureau of Medicine and Surgery.

A schedule of ratings and pay is issued yearly by the Secretary of the Navy for this class of employees under the Naval Establishment, and they are known as the "Excepted Group"; that is, they are excepted by Executive Order from the rules and regulations of the Civil Service. The pay of this group is fixed yearly by the Secretary of the Navy upon the recommendation of a wage board.

The accompanying organization chart is applicable to most 500-bed naval hospitals and may be used as a basis of organization.

¹ Prepared by Chief Pharmacist F. A. Payne, United States Navy.

ORGANIZATION OF COMMISSARY DEPARTMENT.

Office.—The commissary office should be located centrally in the subsistence building, if such a building exists, and contain desks for the commissary officer, commissary steward, and the clerk. Here most of the clerical work of the department is performed, and it should be furnished with one or more typewriters, an adding machine, and a telephone with city connection. In this office are kept the commissary ledger, the dealers' jacket file, commissary department correspondence file, and the provision stock card file. All orders and requisitions for food are prepared here. All matters pertaining to the commissary department are routed through this office for action.

Issuing storeroom.—The issuing storeroom is a room equipped with shelves, bins, and racks for the storage of food in small amounts for immediate issue to the kitchens, wards, and messes. The main hospital refrigerator is considered a part of the issuing storeroom for administrative purposes and is

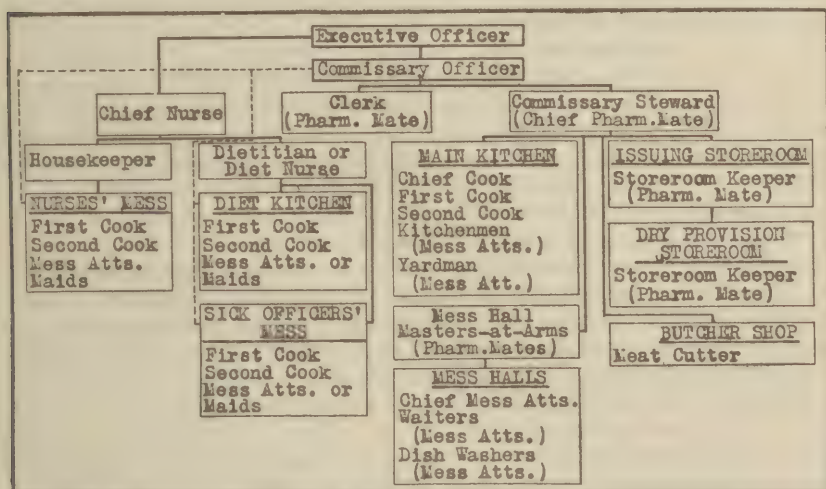


FIG. 206.—Suggested organization of commissary department in 500-bed naval hospitals.

under the charge of the storekeeper. All provisions issued to kitchens, butcher shop, messes, wards, etc., pass directly or indirectly through the issuing room. It is restocked by issues from the dry provision storeroom and by deliveries of fresh provisions from the contractors, and issues from it are made only on the authority of requisitions approved for issue by the commissary officer. It usually is located in the subsistence building in close proximity to the main kitchen. The stock in it has been expended in the commissary ledger, therefore it is not carried as an asset for inventory purposes.

Dry provision storeroom.—The dry provision storeroom is a room in which is kept the reserve stock of dry provisions. It holds from two to three months' supply of provisions of a character that neither deteriorate rapidly nor require refrigeration. All provisions in this storeroom are carried as being "on charge." It is the value of this stock, and this stock only, that is determined monthly by taking inventory and considered as a cash asset for accounting purposes. The stock in it is replenished by requisitions monthly, or when necessary, on the nearest provision depot of the supply department of

the Navy, and from orders placed against existing contracts for special dry provisions not carried in stock in provision depots.

Main kitchen.—The main kitchen is the one in which the food for the general mess (regular diets) is prepared. It is a separate section from the mess halls for administrative purposes, and is under the immediate supervision of the chief cook and includes the main kitchen proper, the bakery, the vegetable preparation room, and such other accessory rooms as may exist, and all of the equipment therein. From this point is distributed the regular diets to the wards and mess halls.

Diet kitchen.—The diet kitchen is not a part of the commissary department, but a discussion of its function will be instructive. Under the general supervision of the chief nurse, it is here that the food for the very sick is prepared or for sick patients for which food other than the regular diet has been prescribed by a medical officer. The diet kitchen usually is located in the subsistence building in the vicinity of the main kitchen. It is under the immediate supervision of the dietitian, or a nurse specially trained in dietetics, and has a personnel of one or more cooks with a sufficient number of mess attendants to perform the rough work and cleaning. The dietitian may have as an assistant another dietitian or a hospital corpsman, so that the service will be continuous. In this kitchen are prepared the liquid diets, soft diets, convalescent diets, and in addition such diabetic, salt free, meat free, or other special diets as may be ordered by medical officers for individual patients. The cooked diets are distributed from this point directly to the wards, as called for on "Special Diet" sheets, N. M. S. Hospital Form 40. Food from this kitchen is never served in the mess halls.

General mess halls.—The mess halls are for the service of food to convalescent patients who are ambulatory, hospital corpsmen, civilian employees, and the marine guard, if one is attached to the hospital. Separate mess rooms are maintained for the four divisions of personnel mentioned. A chief mess attendant is in charge of the dining-room service and has as his assistant as many mess attendants as may be required to wait on the tables and keep the mess halls clean. Usually one mess attendant to every 20 persons is sufficient. The dish-washing room and the mess attendants who wash the dishes are usually under the supervision of the chief mess attendants. The chief mess attendant works under the supervision of the commissary steward and has no control over the patients and others who eat in the mess halls, as they are under the supervision of a master-at-arms detailed for that purpose. A master-at-arms is on duty in the mess halls during each meal to see that order is preserved and that the rules in force at the hospital are carried out.

Sick officers' mess.—The sick officers' mess is maintained in their quarters. Usually these quarters are provided with a mess room and kitchen, and a separate force of cooks and mess attendants. Or, lacking this, the food is prepared in the main kitchen or the diet kitchen, carried in containers to the sick officers' quarters and served either in the dining room or on trays in the patient's room. The nurse in charge of the sick officer's quarters is in charge of this mess, under the supervision of the chief nurse.

Staff officers' mess.—The staff officers' mess generally is located in the sick officers' quarters and uses the same facilities and personnel as the sick officers' mess.

Nurses' mess.—The nurses' mess is conducted in much the same manner as the sick officers' mess. There is a dining room and kitchen provided in their quarters with sufficient cooks and mess attendants to run the mess. The house-

keeper in the nurses' quarters is in charge of this mess under the general supervision of the chief nurse.

MENUS.

Forms used.—In writing menus, S. and A. Form No. 333 (or a similar form) may be used. Menus should be written for three classes of diets: Regular, convalescent, and soft. They should be prepared not later than Tuesday of each week and include seven days—Monday to the following Sunday. They are submitted to the commanding officer through the executive officer for final approval. After being approved they should not be changed except for some very good reason, such as inability to obtain certain articles of provisions, etc.

The writing of regular diet menus only will be discussed in this chapter. For a discussion of soft diets, convalescent diets, and special diets, see the chapter on Foods and Dietetics in this book.

Regular diet menu.—The points to be kept in mind in preparing menus are, first, to feed men in such a manner as to satisfy their bodily requirements; second, to feed them in such a manner as to be pleasing to their senses, thus stimulating their appetites; third, to feed them economically.

A proper regular diet menu should be changed every week to give it variety. No matter how carefully a menu is planned or how well the food is cooked and served, if it is repeated too often it will not give satisfaction. Most persons will tire of chicken and ice cream in the same manner as they do of stew and prunes, if repeated too often or at short intervals.

Before proceeding with this chapter the student should thoroughly familiarize himself with the context of the chapter on "Foods and Dietetics" in this book.

A monotonous diet is liable to lead to loss of appetite if not to so-called food-deficiency diseases, such as scurvy, pellagra, and beriberi. Both in the interest of a man's digestive functions and the proper metabolism of his body, different kinds of foods should be served in such proportion that the proportion of the various foodstuffs, protein, fats, and carbohydrates, are ingested in approximately the proportion of one part of fat, two parts of protein, and eight parts of carbohydrates.

It has been found that man does the best when he ingests animal and vegetable food in the proportion of 20 per cent animal and 80 per cent vegetable.

A man requires from 3,000 to 5,000 calories of foodstuffs per day in the proportion given above, and knowing that 1 gram of protein yields four calories, 1 gram of fat eight calories, and 1 gram of carbohydrates four calories, the caloric value of menus should be figured out from time to time in order to check up the dietary as to whether it is of the proper combination.

When uncooked rations are being served on the basis of a well-balanced ration, quantities should be issued 25 per cent in excess to allow for waste. Experience has shown that with care, waste, such as that made in peeling potatoes and that due to food left on plates, etc., can be kept down to that figure. It will be found that if different kinds of food are served in accordance with the principles of a well-balanced ration, food will not be wasted to any great extent by being left on plates.

It has been found very advantageous to work up a menu by first arranging the dinners for each day, starting in with the meats and building around the main dish as one goes along. By first deciding what meat to run for each day's dinner, it is easier to obtain a rotation in meats, and it also enables one to work in left-over portions for suppers and breakfasts.

In addition to the required amounts of ordinary meats, starchy vegetables, cereals, beverages, etc., some article of fresh fruit, preferably raw, and also some variety of green leafy vegetable should appear each day on the menu. In the summer the selection of these articles is comparatively easy, but in the winter most of them are too expensive for routine use. Therefore the following list is suggested as being best from a combined food value and economic point of view for late fall, winter, and early spring use:

Fresh fruits.—Oranges, lemons, grapefruit, apples, bananas.

Fresh vegetables.—Tomatoes, spinach, lettuce, cabbage, string beans, carrots, cauliflower.

It is a good rule to follow in preparing menus never to open a can when the same article of food is procurable in the market in its fresh condition, provided the fresh article can be purchased at a reasonable price and the personnel of the commissary department is sufficient to prepare the article. It takes more cooks and mess attendants to prepare fresh articles for serving than it does to open cans. Likewise, it is very much easier for the cooks to open cans than it is to get the mess attendants to prepare the fresh articles. Consequently the kitchen requires constant supervision by the commissary officer to see that the fresh articles are procured and prepared rather than having canned goods to cover the menu drawn from the dry provision storeroom. Then, if it is intended to have fresh string beans for a certain meal the words "Fresh string beans" should be written on the menu and not the words "string beans."

Colors of foods.—The color combinations presented when the finished meal is on the plate should be considered in preparing menus. Avoid having foods in the same meal of the same color, as a variety of colors stimulates the appetite. A dinner consisting of cream of potato soup, roast pork, mashed potatoes, stewed dried lima beans, vanilla ice cream, and bread, would be all white in color, but if the soup were changed to vegetable soup, the lima beans to tomato salad, apple sauce served with the roast pork, and the vanilla ice cream changed to chocolate, the color monotony would be broken up very well.

Caloric values.—In order to have a standard as a basis for preparing menus at hospitals in regard to their caloric or fuel value, the caloric value of a "Fresh provision," U. S. Navy ration (given in Gatewood's "Hygiene," as 3,563 calories per day per man) may be taken. It must be understood that the average caloric value for all food consumed in a hospital will be greater than this figure because of the special diets, special messes, and for other reasons. If this standard is accepted for the regular diets the U. S. Navy ration table, as given in the Manual of the Supply Corps, U. S. Navy, 1922, paragraph 1760, may be used as a standard for comparative purposes. For instance, one and three-quarters pounds of fresh meat per day per man is allowed; also one and three-quarters pounds of fresh vegetables; two ounces of butter; four ounces of sugar, etc. By computing the amounts of the various items of provisions used in a hospital a very accurate idea may be had of whether or not excessive amounts of the various items of foods are being used in the menus.

The table given herewith is based on information contained in bulletin No. 28 of the United States Department of Agriculture, "The Chemical Composition of American Food Material;" "Diet in Health and Disease," by Friedenwald and Ruhräh; and "Feeding the Family," by Rose.

No claim is made for mathematical accuracy in presenting this table, as the matter of standardization of weights and measures is exceedingly difficult, especially when an attempt is made to make them agree with average portions. It is believed, however, that this table will be found useful in balancing

menus, so that they may be kept somewhere near the standard selected—that of 3,563 calories per day per man. Where no figures appear in the tables of calorie percentages, no data have been available on which to base computations.

"Average portions" as referred to in the table are considered to be the average amounts required or expected by the average man of good health at one meal in the general mess at naval hospitals.

The abbreviations used in the table are explained as follows:

tsp-----	teaspoonful.	lb-----	pound.
tbsp-----	tablespoonful.	qt-----	quart.
lge-----	large.	sl-----	slice.
med-----	medium.	pc-----	piece.
sml-----	small.	av-----	average.
dia-----	diameter.		

TABLE OF FOODS USUALLY FOUND ON NAVAL HOSPITAL MENUS, SHOWING SIZE OF AVERAGE PORTIONS EXPRESSED IN COMMON HOUSEHOLD MEASURE, WEIGHTS OF PORTIONS, CALORIC VALUES, AND PERCENTAGE OF PROTEIN, FAT, AND CARBOHYDRATE CALORIES.

BEVERAGES.

		Ounces.	Calo-ries.	Pro-tein.	Fat.	Car-bohy-drate.
Cocoa (1 cup milk, 2 tsp. cocoa, 2 tsp. sugar).	1 cup-----	9.5	250	16	44	40
Eggnog-----	1 cup-----	7.4	200	21	48	31
Lemonade-----	1 cup-----	7.0	70			100
Coffee-----	1 cup-----	8.0	0			
Tea-----	1 cup-----	8.0	0			

BREADS, BISCUITS, MUFFINS.

NOTE.—Add 160 calories to caloric values of breads, etc., listed below, if butter (0.8 oz.) is served with the breads.

Baking powder biscuits.....	2 sml. biscuits.....	1.3	100	11	27	62
Bread, Boston, brown.....	1 sl. 3 1/4" x 3" dia.....	1.8	100	10	10	80
Bread, Graham.....	3 sl. 3 1/2" x 2" x 3 1/4".....	1.4	100	14	6	80
Bread, corn, old New England.....	1 pc. 2 1/2" x 2" x 1".....	2.0	200	8	30	62
Bread, white.....	2 sl. 4" x 4" x 1 1/2".....	1.6	100	14	6	80
Bread, whole wheat.....	2 sl. 2 1/2" x 2 3/4" x 1 1/2".....	2.8	200	16	3	81
Bread, corn cake.....	2 sl. 2" x 2" x 1".....	2.4	200	10	24	66
Oyster crackers.....	24 crackers.....	0.8	100	10	22	68
Saltines.....	6 crackers.....	0.8	100	10	26	64
Soda crackers.....	4 crackers.....	0.9	100	10	20	70
Croutons (toasted).....	15 croutons, 1/2" cubes.....	0.8	100	7	49	44
Griddle cakes.....	3 cakes, 4 1/2" dia.....	5.4	300	14	25	61
Muffins, cornmeal.....	2 muffins.....	3.2	266	13	25	62
Sandwich, club.....	1 sandwich.....	9.0	600	15	69	16
Toast, cream.....	1 sl. with 1/4 cup sauce.....	3.6	165	13	43	44
Toast, French.....	2 sl. 3" x 3 1/2" x 1 1/2".....	2.8	200	10	48	42

CAKES, ETC.

Angel cake.....	1 pc. 1 1/4" x 2" x 2 1/2".....	1.3	100	12	1	87
Apple sauce cake.....	1 pc. 1 1/2" x 3 3/4" x 1".....	1.6	200	5	11	84
Chocolate loaf.....	1 pc. 2 1/2" x 5" x 1 1/2".....	1.8	200	5	41	54
Doughnuts.....	1 doughnut.....	1.6	200	6	45	49
Fruit cake.....	1 pc. 1 7/8" x 1 7/8" x 3/4".....	1.8	200	6	26	68
Gingerbread.....	1 pc. 2" cube.....	2.4	200	8	22	70
One-egg cake.....	1 pc. 1 3/4" x 1 3/4" x 3 1/2".....	2.0	200	8	32	60
Cookies, plain.....	3 cookies 2 1/2" dia.....	2.7	150	6	33	61
Sponge cake.....	1 pc. 1 1/2" x 1 1/2" x 2".....	0.9	100	11	19	70
Icing, "White Mountain".....	1 1/2 tbsps.....	0.5	50	1		69

TABLE OF FOODS USUALLY FOUND ON NAVAL HOSPITAL MENUS,
ETC.—Continued.

SUGARS AND SYRUPS.

		Ounces.	Calo- ries.	Pro- tein.	Fat.	Car- bohy- drate.
Maple syrup.....	1½ tbsp.....	1.2	100	.....	.....	100
Molasses.....	1½ tbsp.....	1.2	100	3	.....	97
Sugar, white, granulated.....	2 tbsp. (scant).....	0.9	100	.....	.....	100
Sugar, white, powdered.....	2 tbsp.....	0.9	100	.....	.....	100
Sugar, brown.....	2 tbsp.....	0.9	100	.....	.....	100

CEREALS.

NOTE.—Add 100 calories to caloric value of any cereal given below to allow for milk (4 oz.) and sugar (2 tsp) if served.

Cornflakes.....	1 cup.....	0.8	80	6	4	90
Cornmeal, cooked.....	2½ cup.....	6.0	100	10	5	85
Farina.....	¾ cup.....	6.0	100	12	4	84
Grapenuts.....	3 tbsp.....	1.0	100	12	2	86
Hominy grits, cooked.....	¾ cup.....	6.8	100	12	1	90
Macaroni, cooked.....	1 cup.....	5.2	100	15	2	83
Macaroni croquette.....	1 croquette.....	1.2	100	10	45	45
Macaroni, tomato sauce.....	5 tbsp.....	3.6	100	10	36	54
Oatmeal, cooked.....	1 cup.....	7.9	100	17	16	67
Puffed rice.....	1½ cups.....	1.0	100	9	1	90
Puffed wheat.....	1½ cups.....	1.0	100	15	3	82
Rice, steamed.....	¾ cup.....	4.0	100	9	1	90
Shredded wheat.....	1 biscuit.....	0.9	100	13	5	82

PUDDINGS, ICE CREAMS, ETC.

Apple tapioca.....	½ cup.....	7.2	200	1	1	98
Boiled custard.....	¾ cup.....	6.6	300	13	44	43
Brown Betty.....	½ cup.....	5.0	250	3	35	62
Bread pudding, raisin.....	½ cup.....	5.0	250	.....	.....	.....
Cornstarch, blanc mange.....	½ cup.....	5.4	200	8	33	59
Cottage pudding.....	1 pc. 2" x 2½" x 1¾"	1.1	100	7	26	67
Custard pudding.....	2½ cup.....	6.6	200	17	39	44
Lemon ice.....	½ cup.....	3.1	100	.....	.....	100
Lemon jelly.....	½ cup.....	3.8	100	9	.....	91
Lemon milk sherbet.....	½ cup.....	3.8	200	4	12	84
Peach ice cream.....	½ qt.....	3.0	180	4	51	45
Prune soufflé.....	½ cup.....	2.2	125	10	.....	90
Raspberry sherbet.....	½ cup.....	4.2	200	1	.....	99
Rice pudding, raisins.....	½ cup.....	2.0	120	12	27	61
Snow pudding.....	¾ cup.....	2.2	100	10	.....	90
Vanilla ice cream (1 qt. 20 per cent cream; ¾ cup sugar; 1½ tsp. Vanilla extract).	½ qt.....	3.2	200	4	63	33

DAIRY PRODUCTS.

Butter.....	½ lb.....	0.8	160	1	99	.....
Cheese, American, full cream.....	1 pc. 2" x 1" x ¾"	0.9	100	25	72	3
Cheese, cottage.....	2 tbsp.....	1.2	40	76	9	15
Cream, 20 per cent.....	2 tbsp.....	0.25	25	5	86	9
Cream, 40 per cent.....	1 tbsp.....	0.7	75	2	95	3
Cream, whipped.....	1 tbsp.....	0.45	50	2	95	3
Milk, condensed.....	1 tbsp.....	0.7	65	11	23	66
Milk, evaporated.....	1 tbsp.....	0.5	25	23	51	26
Milk, fresh.....	1 cup.....	8.1	160	19	52	29

EGGS AND CHEESE DISHES.

Eggs, raw.....	2 eggs.....	4.0	150	36	64	.....
Eggs, scrambled.....	½ cup.....	4.2	200	20	76	11
Macaroni and cheese.....	½ cup.....	2.1	100	17	39	44
Welsh rarebit.....	3 tbsp. rarebit and 1 sl. toast.....	2.6	200	22	57	21

TABLE OF FOODS USUALLY FOUND ON NAVAL HOSPITAL MENUS,
ETC.—Continued.

FRUITS.

		Ounces.	Calo- ries.	Pro- tein.	Fat.	Car- bohy- drate.
Apple, baked, with 2 tbsp. sugar.	1 med. sized apple.....	3.5	150	1	3	96
Apple, baked, with cream.	1 med. sized apple.....	5.0	200	1	31	68
Apple, fresh, raw.	1 med. sized apple.....	5.0	65	3	5	92
Apple sauce.	$\frac{3}{4}$ cup.....	3.5	100	1	3	96
Apricots, canned.	3 lge. halves with 2 tbsp. juice.	4.8	100	5		95
Apricots, dried, stewed.	$\frac{1}{4}$ cup.....	2.7	100	4	2	94
Bananas.	1 med. sized banana.....	4.5	80	5	6	89
Blackberries, fresh.	1 cup.....	12.2	200	9	16	75
Blackberries, stewed.	$\frac{1}{2}$ cup.....	4.4	200	2	4	94
Cantaloupe.	$\frac{1}{2}$ melon, 4 $\frac{1}{2}$ " dia.	9.0	50	6		94
Cranberry jelly.	2 tbsp.....	1.5	100		1	99
Cranberry sauce.	$\frac{1}{2}$ cup.....	1.5	100		1	99
Grapefruit.	$\frac{1}{2}$ large.....	6.0	80			
Grape juice.	$\frac{1}{4}$ cup.....	3.5	100			100
Grapes, Concord.	1 lge. bunch.....	4.9	100	5	15	80
Grapes, Malaga.	22 grapes.....	3.7	100	5	15	80
Huckleberries, fresh.	1 cup.....	4.7	100	3	7	90
Lemons.	1 large.....	3.8	35	9	15	76
Olives, green.	3-4 olives.....	0.8	50	1	83	16
Oranges.	1 large.....	9.5	100	7	2	91
Peaches, fresh.	3 medium.....	10.5	100	6	3	91
Peaches, canned.	2 lge. halves and 3 tbsp. juice.	7.5	100	6	2	92
Peaches, stewed.	$\frac{1}{2}$ cup.....	3.5	100	2		98
Pears, fresh.	2 medium.....	6.3	100	4	6	90
Pears, canned.	2 halves and 2 tbsp. juice.	3.0	65	2	4	94
Pineapple, canned, sliced.	1 sl. and 3 tbsp. juice.	2.3	100	1	4	95
Pineapple, fresh.	1 sl. 1" thick.....	4.1	50	4	6	90
Plums, fresh.	2 large.....	2.2	50	5		95
Prunes, stewed.	4 prunes and 4 tbsp. juice.	5.6	200	2		98
Raisins.	$\frac{1}{4}$ cup.....	1.1	100	3	9	88
Raspberries.	1 cup.....	5.0	90	10	14	76
Rhubarb.	$\frac{1}{2}$ cup.....	1.7	160	1	2	97
Strawberries, fresh.	1 cup.....	6.6	75	10	14	76
Watermelon, edible portion.	Large portion.....	11.7	100	5	6	89

MEATS, COOKED.

Beef, corned (less $\frac{3}{4}$ fat content).	1 sl. 4 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ " x $\frac{3}{8}$ "	3.0	100	53	47	
Beef, dried, creamed.	$\frac{1}{2}$ cup.....	2.3	100	20	62	18
Beef, hamburger steak, broiled.	2 cakes, 2 $\frac{1}{2}$ " dia. x $\frac{7}{8}$ " thick.	4.0	200	55	45	
Beef, heart, stuffed.	2 1. 2 $\frac{1}{2}$ " x 2 $\frac{1}{4}$ " x $\frac{1}{4}$ "	2.0	200	21	68	11
Beef, loaf.	1 sl. 4" x 6" x $\frac{1}{4}$ "	3.0	200	40	60	
Beef, pie.	1 serving.....	6.8	400	10	43	47
Beef, rib, lean, roasted.	1 sl. 5" x 5" x $\frac{1}{4}$ "	3.2	200	46	54	
Beef, round, lean, boiled.	1 serving.....	3.3	150	90	10	
Beef, round, lean, pot roast.	1 serving.....	3.3	200	62	38	
Beef, round steak, pan broiled.	1 pc. 4" x 6" x 1 $\frac{1}{8}$ "	4.0	200	48	52	
Beef, sirloin, med. fat, broiled.	1 pc. 4 $\frac{1}{2}$ " x 1 $\frac{3}{4}$ " x $\frac{3}{4}$ "	4.0	300	31	69	
Beef stew with vegetables.	1 cup.....	7.5	250	16	45	39
Frankfurters.	2 sausages.....	2.2	200	31	67	2
Lamb chops, broiled.	2 chops, meat portion, 2" x 2" x $\frac{1}{2}$ "	3.8	200	40	60	
Lamb, leg, roast.	1 sl. 3 $\frac{1}{2}$ " x 4 $\frac{1}{2}$ " x $\frac{1}{4}$ "	3.6	200	41	59	
Mutton, leg, roast.	1 sl. 3" x 3 $\frac{3}{4}$ " x $\frac{3}{8}$ "	3.6	300	33	67	
Pork, (bacon).	4-5 sml. sl.	0.5	100	13	87	
Pork, (ham, boiled).	1 sl. 4 $\frac{3}{4}$ " x 4" x $\frac{1}{8}$ "	2.6	200	29	71	
Pork, loin, roast.	1 serving.....	4.0	300	33	67	
Pork, loin, chop.	1 chop.....	4.0	250	33	67	
Pork sausage, broiled.	3 sausages, 3" long, $\frac{3}{4}$ " dia.	2.2	200	20	78	
Poultry:						
Chicken, broiled.	$\frac{1}{4}$ of av. 1 $\frac{1}{2}$ lb. broiler.	3.2	100	80	20	
Chicken, roast.	1 serving.....	4.0	250	51	49	
Turkey, roast.	1 serving.....	4.0	340	40	60	
Poultry stuffing.	$\frac{1}{2}$ cup.....	1.6	200	9	48	43
Veal cutlets, breaded.	1 serving.....	5.0	250	30	52	18
Veal, leg, roast.	1 sl. 2" x 2 $\frac{3}{4}$ " x $\frac{1}{4}$ "	5.0	250	71	29	
Veal (liver, calf).	1 serving.....	4.2	200	47	53	
Irish stew with dumplings.	1 cup with 1 dumpling.		450			
Hash, fresh, 50 per cent meat, 50 per cent potatoes.	1 cup.....	12.0	350			

TABLE OF FOODS USUALLY FOUND ON NAVAL HOSPITAL MENUS.
ETC.—Continued.

FISH AND SHELLFISH.

		Ounces.	Calo- ries.	Pro- tein.	Fat.	Car- bohy- drate.
Bluefish.....	1 serving.....	3.8	150	72	28	.....
Codfish balls.....	2 balls, 2" dia.....	3.4	200	14	65	21
Codfish, creamed.....	½ cup.....	2.5	100	32	46	22
Halibut steak, broiled.....	1 pc. 3" x 2½" x 1".....	3.0	100	61	39	.....
Mackerel, Spanish, broiled.....	1 serving.....	3.9	150	56	44	.....
Salmon, canned.....	½ cup.....	2.0	125	45	55	.....
Salmon, creamed, on toast.....	½ cup salmon and 1 sl. toast.....	4.8	200	22	42	36
Salmon, loaf.....	½ cup.....	4.2	200	37	52	11
Sardines, canned.....	3-6 sardines.....	1.7	100	46	54	.....
Clams.....	6 clams or ½ cup.....	7.6	100	56	8	36
Lobster, canned.....	½ cup.....	2.8	65	86	12	2
Oysters.....	¾ cup or 6-15 oysters.....	7.2	100	49	24	27
Shrimp.....	½ cup.....	3.2	100	91	8	1

PIES.

Apple.....	¼ of a 9" pie.....	4.8	300	3	41	56
Cranberry.....	¼ of a 9" pie.....	4.8	340	2	18	80
Custard.....	¼ of a 9" pie.....	4.3	225	9	32	59
Lemon meringue.....	¼ of a 9" pie.....	4.5	450	5	27	68
Mince.....	¼ of a 9" pie.....	5.4	450	8	39	53
Raisin and cranberry.....	¼ of a 9" pie.....	4.5	450	3	27	70
Rhubarb.....	¼ of a 9" pie.....	5.0	300	5	18	77
Squash.....	¼ of a 9" pie.....	4.0	225	10	25	65
Pumpkin.....	¼ of a 9" pie.....	4.0	200	10	25	65

SALADS AND DRESSINGS.

Banana salad.....	1 serving.....	4.0	150	12	36	52
Cabbage salad.....	½ cup.....	1.4	50	6	78	16
Cheese and pineapple salad.....	1 serving.....	3.4	200	9	58	33
Chicken salad.....	1 serving.....	3.2	200	12	86	2
Egg salad.....	1 serving.....	3.5	250	14	85	1
French dressing.....	1½ tbsp.....	0.6	100	.....	100	.....
Fruit salad.....	½ cup and 1 tbsp. dressing.....	3.0	200	3	75	22
Lettuce salad with French dressing.....	1 serving.....	2.4	200	1	95	11
Mayonnaise dressing.....	1 tbsp.....	0.5	100	1	97	11
Potato salad.....	1 serving.....	3.4	200	3	68	29
Tomato and cucumber salad.....	1 serving.....	3.0	150	4	81	15
Tomato and lettuce salad.....	1 serving.....	5.4	200	3	86	11
Waldorf salad.....	1 serving.....	3.0	250	4	76	20

Soups.

Asparagus, cream of.....	1 cup.....	8.0	100	17	56	27
Bouillon.....	1 cup.....	8.0	25	84	8	8
Celery, cream of.....	1 cup.....	7.2	200	11	61	28
Corn, cream of.....	1 cup.....	7.8	230	12	38	50
Green pea, cream of.....	1 cup.....	7.8	150	16	46	38
Oyster stew.....	1 cup.....	9.0	200	16	63	21
Potato.....	1 cup.....	8.5	200	15	38	47
Split pea.....	1 cup.....	10.0	250	26	2	72
Tomato.....	1 cup.....	9.0	135	12	12	76
Tomato, cream of.....	1 cup.....	8.5	260	11	63	20

TABLE OF FOODS USUALLY FOUND ON NAVAL HOSPITAL MENUS,
ETC.—Continued.

VEGETABLES.

		Ounces.	Calo- ries.	Pro- tein.	Fat.	Car- bohy- drate.
Asparagus.....	5 lge. stalks, 8" long.....	4.0	25	32	8	60
Beans, baked.....	1 cup.....	8.0	300	21	18	61
Beans, kidney, stewed.....	½ cup.....	4.9	100	26	18	56
Beans, lima, dried.....	½ cup.....	1.0	100	26	5	69
Beans, string.....	1 cup.....	3.6	45	22	7	71
Beets.....	1 beet, 2" dia.....	2.0	25	14	2	84
Cabbage.....	1 cup.....	2.0	20	20	9	71
Carrots.....	1 young carrot, 4" long.....	2.0	20	10	5	85
Cauliflower.....	¼ of small head.....	2.0	20	23	15	62
Celery.....	1 serving.....	1.0	6	24	5	71
Corn, a la Southern.....	½ cup.....	3.4	100	16	41	43
Corn, canned.....	½ cup.....	3.6	100	11	11	78
Corn on cob.....	2 ears, 6" long.....	9.0	100	12	0	79
Cucumbers.....	½ cucumber, 7" long.....	2.4	10	19	12	69
Lettuce.....	1 serving.....	1.0	6	25	14	61
Onions, raw.....	1 medium.....	2.0	25	13	6	81
Onions, fried.....	1 serving.....	3.0	60			
Onions, escalloped.....	½ cup.....	2.5	100	8	59	33
Peas, canned.....	½ cup, drained.....	3.0	65	26	3	71
Peas, creamed.....	½ cup.....	2.7	100	18	37	45
Peppers, stuffed, meat and bread crumbs.....	1 pepper.....	6.0	250	11	21	68
Potatoes, sweet, baked.....	1 medium.....	6.0	200	6	5	89
Potatoes, sweet, candied.....	1 small.....	4.0	200	4	7	89
Potatoes, white, baked.....	1 large.....	5.0	165	11	1	88
Potatoes, white, boiled.....	1 large.....	5.4	150	11	1	88
Potatoes, white, creamed.....	¾ cup.....	5.4	200	0	50	41
Potatoes, white, mashed.....	1 cup.....	6.0	200	7	43	45
Potatoes, white, escalloped.....	½ cup.....	3.5	100	9	30	61
Potatoes, white, fried.....	1 serving.....	5.0	200			
Radishes, red, turnip.....	6 medium.....	2.0	16	18	3	79
Spinach, boiled.....	1 cup.....	8.0	40	12	8	80
Spinach, boiled with egg.....	¾ cup.....	7.6	100	10	70	20
Succotash.....	½ cup.....	5.3	150	15	9	76
Tomatoes, canned.....	½ cup.....	4.4	30	21	8	71
Tomatoes, fresh.....	1 medium.....	5.0	35	16	16	68
Tomatoes, stuffed.....	1 tomato.....	4.0	100	13	45	42
Turnips, creamed.....	½ cup.....	1.4	100	13	5	82

MISCELLANEOUS.

Nuts, mixed.....	1 serving (estimated).....	1.0	200	10	82	8
Coconut, prepared.....	¼ cup.....	0.6	100	4	77	19
Peanut butter.....	2½ tsp.....	0.6	100	19	69	12

SAMPLE WINTER MENU FOR THE GENERAL MESS, SHOWING APPROXIMATE CALORIC VALUES OF THE ITEMS.

	Breakfast.	Dinner.	Supper.
MONDAY.	Corn flakes and milk.... 180 Hamburger steak..... 200 Baked potatoes..... 165 Corn bread and butter... 360 Coffee..... 905	Roast loin of pork..... 300 Boiled sweet potatoes.... 200 Fresh apple sauce..... 100 String bean and lettuce salad..... 100 Pumpkin pie..... 200 Bread, butter, coffee..... 260 1,160	Boston baked beans..... 300 French-fried potatoes.... 150 Fruit salad..... 200 Brown bread and butter. 260 Tea and milk..... 160 1,070
TUESDAY.	Baked apples and cream. 200 Pork sausage..... 200 Griddle cakes..... 100 Maple syrup..... 100 Bread, butter, coffee..... 260 860	Porterhouse steak, gravy.. 300 Fried onions..... 60 Mashed potatoes..... 200 Celery..... 200 Custard pudding..... 200 Bread, butter, coffee..... 260 1,020	Oyster stew..... 200 Crackers..... 100 Cold sliced meats..... 200 Potato salad..... 200 Spiced pears..... 100 Bread and butter..... 260 Cocoa..... 250 1,310
WEDNESDAY.	Shredded wheat and milk 200 Fried eggs..... 150 Fried bacon..... 100 Hot rolls and butter..... 260 Coffee..... 710	Cream of tomato soup.... 260 Roast lamb, mint sauce... 200 Roast brown potatoes.... 165 Stewed canned peas..... 65 Lemon sherbet..... 100 Bread, butter, coffee..... 260 1,050	Meat croquettes..... 250 Creole rice..... 100 Cabbage salad..... 50 Brown Betty pudding... 250 Bread, butter, tea..... 260 910
THURSDAY.	Oranges..... 100 Creamed chipped beef on toast..... 300 Fried potatoes..... 120 Coffee..... 520	Chicken potpie..... 300 Baked sweet potatoes.... 200 Baked squash..... 100 Fruited rice pudding.... 120 Bread, butter, coffee..... 260 980	Pork chops..... 300 Cottage fried potatoes... 150 Combination salad..... 200 Stewed apricots with raisins..... 100 Bread and butter..... 260 Tea and milk..... 160 1,170
FRIDAY.	Rolled oats and milk.... 200 Fresh meat hash..... 200 Soft boiled eggs..... 75 Hot rolls and butter..... 260 Coffee..... 735	Bean soup..... 250 Boiled fresh salmon..... 150 Hollandaise sauce..... 50 Mashed potatoes..... 200 Escalloped tomatoes.... 100 Fresh apple pie, cheese. 300 Bread, butter, coffee..... 260 1,310	Clam chowder..... 225 Baked macaroni and cheese..... 200 Asparagus salad..... 200 Dill pickles..... 200 Ginger bread..... 200 Bread and butter..... 260 Cocoa..... 250 1,335
SATURDAY.	Puffed wheat and milk.. 200 Broiled pork sausage.... 200 Creamed potatoes..... 200 Bread, butter, coffee..... 260 860	Pot roast of beef..... 200 Brown gravy..... 50 Boiled potatoes..... 150 Creamed turnips..... 100 Bread custard with raisins. 260 Bread, butter, coffee..... 260 1,020	Codfish cakes..... 200 Tomato sauce..... 50 Spinach with egg..... 100 Bananas..... 100 Bread, butter, tea..... 260 710
SUNDAY.	Grapefruit..... 80 Broiled ham..... 200 Scrambled eggs..... 200 Hot rolls and butter..... 260 Coffee..... 740	Asparagus soup..... 125 Roast chicken..... 250 Mashed potatoes..... 200 Sage dressing..... 200 Cranberry sauce..... 100 Celery and olives..... 50 Vanilla ice cream..... 200 Bread, butter, coffee..... 260 1,385	Shrimp salad..... 150 Creamed potatoes..... 200 American cheese..... 100 Sliced pineapple..... 100 Raisin loaf cake..... 150 Bread and butter..... 260 Cocoa..... 250 1,210

When the caloric values are totaled by days, allowing 600 calories each day for incidental articles of food used in cooking and flavoring, such as sugar and milk in the coffee and tea, flour and cornstarch used by the cooks as "thickening," etc., it will be found that the menu given above will total as follows:

Monday	3, 735
Tuesday	3, 790
Wednesday	3, 270
Thursday	3, 270
Friday	3, 980
Saturday	3, 190
Sunday	3, 953
Average for 1 day	3, 595

In order to show the approximate amounts of the various nonstock items to order for a menu the following list is suggested, based on a complement of 400 rations:

Amount.	Delivery day.
600 pounds beef in sides (2 sides)	Monday.
300 pounds loins of beef	Monday.
300 pounds loins of pork	Saturday before.
250 pounds of fowl, dressed and drawn	Wednesday.
300 pounds chicken, dressed and drawn	Saturday.
400 pounds of lamb, carcasses	Tuesday.
150 pounds salmon	Thursday.
10 gallons clams	Friday, a. m.
10 gallons oysters	Tuesday, a. m.
40 pounds codfish, shredded	Friday.
150 pounds pumpkins	Saturday before.
5 pounds mint	Tuesday.
200 pounds squash	Wednesday.
150 pounds turnips	Friday.
60 pounds cake	Saturday.

No estimates will be given for the remaining items of food on the menu, as they all are items which should be carried as stock items, and sufficient amounts of them should be in store at all times to meet ordinary demands.

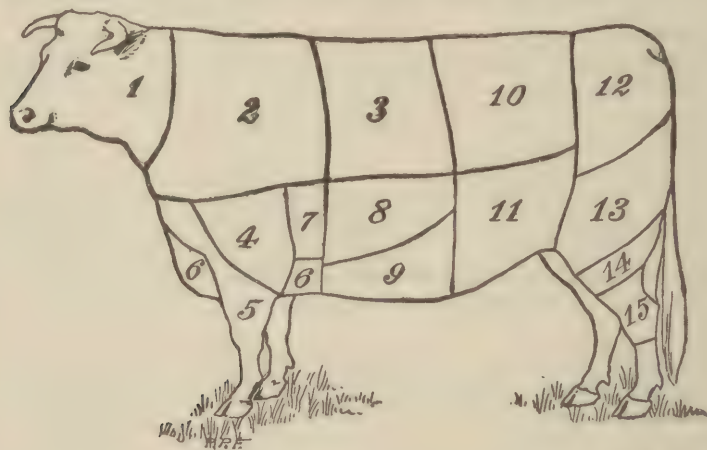
The two sides of beef should be cut up and used as follows:

2 rounds	}	Use as pot roast for Saturday dinner.
2 sirloin butts		
2 chucks		
2 shoulder clods		
2 loins		Use as beefsteak for Tuesday dinner.
2 eight-rib cuts		Use as cold sliced meats for Tuesday supper.

The briskets, cross ribs, plates, navels, rumps, and flanks remaining can be used as hamburger steak on Monday. The two loins of beef trimmed out of the two sides may be added to the 300 pounds of loins ordered for Monday and cut up into steaks for the Tuesday dinner. The lamb carcasses should be cut up into legs, shoulders, racks, and loins. The legs and shoulders to be used as roast lamb for Wednesday and the loins and racks saved for issue to the special diets as lamb chops. There will be sufficient meats left over during the week to provide left-over meats from which to make the croquettes Wednesday and fresh-meat hash on Friday.

CUTS OF MEATS.²

"The methods of cutting sides of beef, veal, mutton, and pork into parts, and the terms used for the different 'cuts,' as these parts are commonly called,



1. Neck.
2. Chuck.
3. Ribs.
4. Shoulder clod.
5. Fore shank.
6. Brisket.
7. Cross ribs.
8. Plate.
9. Navel.
10. Loin.
11. Flank.
12. Rump.
13. Round.
14. Second cut round.
15. Hind shank.



FIG. 207.—Diagrams of cuts of beef. (U. S. Department of Agriculture Bulletin No. 28.)

vary in different localities. The analyses here reported apply to cuts as indicated by the following diagrams. These show the positions of the different cuts, both in the live animal and the dressed carcass as found in the markets.

² Department of Agriculture Bulletin No. 28.

The lines of division between different cuts will vary slightly, according to the usage of the local market, even where the general method of cutting is as here indicated. The names of the same cuts likewise vary in different parts of the country.

The cuts of beef.—The general method of cutting up a side of beef is illustrated in figure 207, which shows the relative position of the cuts in the animal and in a dressed side. The neck piece is frequently cut so as to include more of the chuck than is represented by the diagrams. The shoulder clod is usually cut without bone, while the shoulder (not indicated in diagram) would include more or less of the shoulder blade and of the upper end of the fore shank. Shoulder steak is cut from the chuck. In many localities the plate is made to include all the parts of the fore quarter designated on the diagrams as brisket, cross ribs, plate, and navel, and different portions of the plate as thus cut are spoken of as the 'brisket end of plate' and 'navel end of plate.' This part

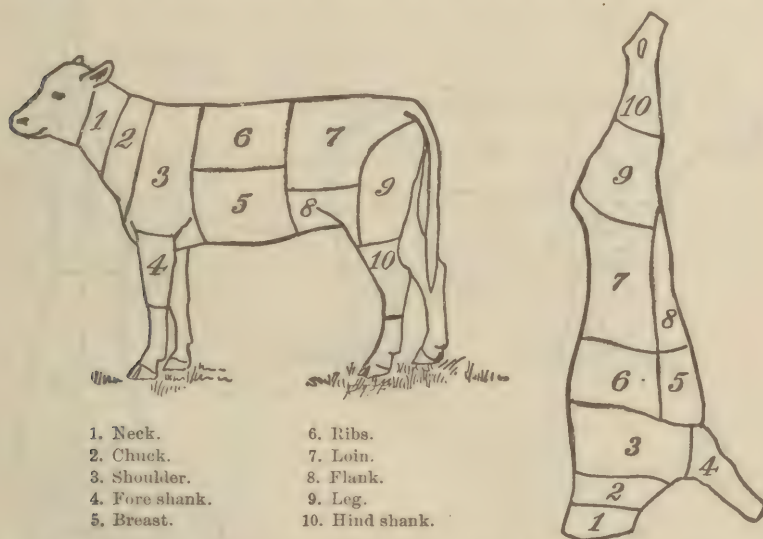


FIG. 208. Diagrams of cuts of veal. (U. S. Department of Agriculture Bulletin No. 28.)

of the animal is largely used for corning. The ribs are frequently divided into first, second, and third cuts, the latter lying nearest the chuck and being slightly less desirable than the former. The chuck is sometimes subdivided in a similar manner, the third cut of the chuck being nearest the neck. The names applied to different portions of the loin vary considerably in different localities. The part nearest the ribs is frequently called 'small end of loin' or 'short steak.' The other end of the loin is called 'hip sirloin' or 'sirloin.' Between the short and the sirloin is a portion quite generally called the 'tenderloin,' for the reason that the real tenderloin, the very tender strip of meat lying inside the loin, is found most fully developed in this cut. Porterhouse steak is a term most frequently applied to either the short steak or the tenderloin. It is not uncommon to find the flank cut so as to include more of the loin than is indicated in the figures, in which case the upper portion is called 'flank steak.' The larger part of the flank is, however, very frequently corned, as is also the case with the rump. In some markets the rump is cut so as to include a portion of the loin, which is then sold as 'rump steak.' The portion of the round on the inside of the leg is regarded as more tender than on the

outside, and is frequently preferred to the latter. As the leg lies upon the butcher's table this inside of the round is usually on the upper or top side, and is therefore called 'top round.' Occasionally the plate is called the 'rattle.'

"The cuts of veal."—The method of cutting up a side of veal differs considerably from that employed with beef. This is illustrated by figure 208, which shows the relative position of the cuts in the animal and in a dressed side. The chuck is much smaller in proportion, and frequently no distinction is made between the chuck and the neck. The chuck is often cut so as to include a considerable of the portion here designated as shoulder, following more nearly the method adopted for subdividing beef. The shoulder of veal as here indicated includes, besides the portion corresponding to the shoulder in beef, the larger part of what is here classed as chuck in the adult animal. The under

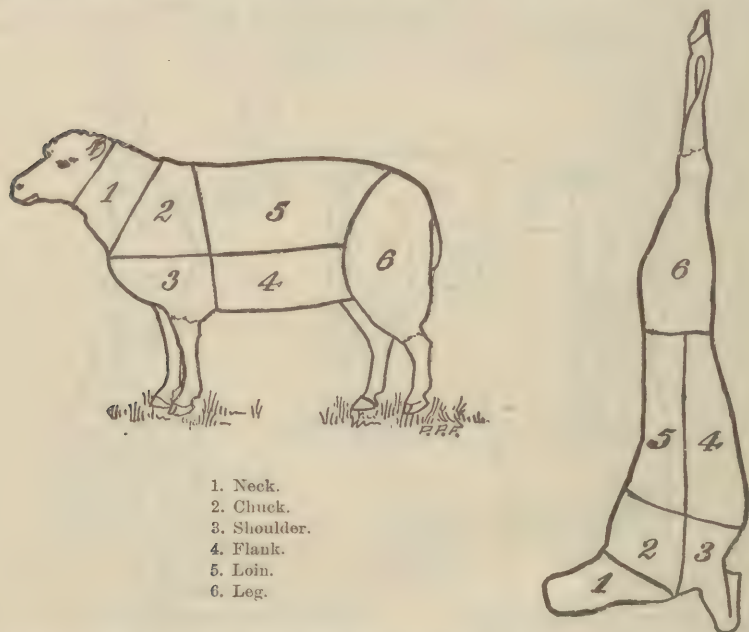


FIG. 209.—Diagrams of cuts of lamb and mutton. (U. S. Department of Agriculture Bulletin No. 28.)

part of the fore quarter, corresponding to the plate in the beef, is often designated as breast of veal. The part of the veal corresponding to the rump of beef is here included with the loin, but is often cut to form part of the leg. In many localities the fore and hind shanks of veal are called the 'knuckles.'

"The cuts of lamb and mutton."—Figure 209 shows the relative position of the cuts in a dressed side of mutton or lamb and in a live animal. The cuts in a side of lamb and mutton number but six, three in each quarter. The chuck includes the ribs as far as the end of the shoulder blades, beyond which comes the loin. The flank is made to include all the under side of the animal. Some butchers, however, make a larger number of cuts in the fore quarter, including a portion of the cuts marked 'loin' and 'chuck' in figure 209, to make a cut designated as 'rib,' and a portion of the 'flank' and 'shoulder' to make a cut designated as 'brisket.' The term 'chops' is ordinarily used to designate por-

tions of either the loin, ribs, chuck or shoulder, which are either cut or 'chopped' by the butcher into pieces suitable for frying or broiling. The chuck and ribs are sometimes called the 'rack.'

"*The cuts of pork.*—The method of cutting up a side of pork differs considerably from that employed with other meats. A large portion of the carcass of a dressed pig consists of almost clear fat. This furnishes the cuts which are used for 'salt pork' and bacon. Figure 210 illustrates a common method of cutting up pork, showing the relative position of the cuts in the animal and in the dressed side. The cut designated as 'back cut' is almost clear fat, and is used for salting and pickling. The 'middle cut' is the portion quite generally used for bacon and for 'lean ends' salt pork. The belly is salted or pickled or may be made into sausages.

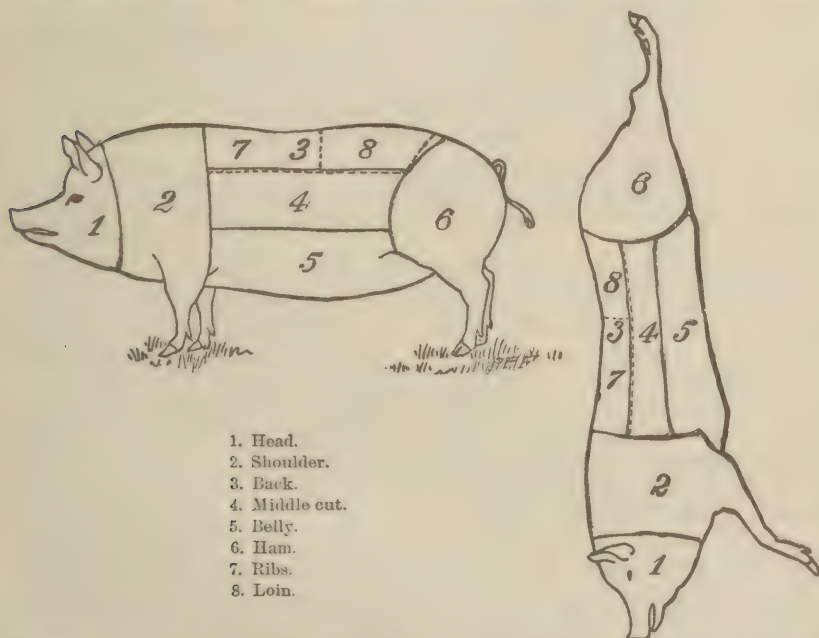


FIG. 210.—Diagrams of cuts of pork. (U. S. Department of Agriculture Bulletin No. 28.)

"Beneath the 'back cut' are the ribs and loin, from which are obtained 'spareribs,' 'chops,' and roasting pieces, here designated by dotted lines. The hams and shoulders are more frequently cured, but are also sold fresh as pork 'steak.' The tenderloin proper is a comparatively lean and very small strip of meat lying under the bones of the loin and usually weighing a fraction of a pound. Some fat is usually trimmed off from the hams and shoulders which is called 'ham and shoulder fat' and is often used for sausages, etc. What is called 'leaf lard,' at least in some localities, comes from the inside of the back. It is the kidney fat.

"As stated above, cuts as shown in the diagrams herewith correspond to those of which analyses are reported in the table beyond, but do not attempt to show the different methods of cutting followed in markets in different parts of the United States."

PROVISIONS AND HOW THEY ARE PROCURED.

Provisions may be divided into two classes: Dry provisions and fresh provisions. Dry provisions may be subdivided into two classes for the purpose of this discussion: Dry provisions, Navy standard, and dry provisions, special, for hospitals only.

Dry provisions, Navy standard.—Dry provisions, Navy standard, are those items of groceries that have been standardized by the Navy Department, defined by printed specifications (see "Index of Specifications issued by the Navy Department" issued quarterly by the Bureau of Supplies and Accounts) and carried in stock by all naval provision depots.

To obtain provisions of this character requisition is made on the nearest provision depot using S. and A. Form No. 30.

In order to obtain fresh provisions and dry provisions, special, for hospitals only, it is necessary to furnish the local supply officer, annually, by the first of March, a list showing the estimated amounts of these two classes of provisions that will be needed to meet the requirements of the hospital during the following fiscal year. This list should show the amounts required by months. If the list is prepared properly and carefully and the season rotation of fruits and vegetables taken into consideration, very little difficulty will be experienced in obtaining the various kinds of fresh provisions as they appear in the local markets.

Basing future requirements on this list the supply officer makes requisition on the Bureau of Supplies and Accounts for these amounts plus such amounts as may be required and are authorized for other naval activities within the district, and upon the approval of the bureau, he makes monthly contracts to furnish these items. After the contracts are made, each activity concerned is supplied with a "Schedule of Provision Contracts" for the following month. This schedule shows the names, addresses, and telephone numbers of all firms holding contracts during the month, together with the contract numbers and unit prices. In addition to the list of provisions contracted for delivery to the "General Service," i. e., ships and stations, there will be given a list of items for the use of "Hospitals Only." Naval hospitals may order from both lists. This latter list shows such items of dry provisions, special, for hospitals only, as have been included in the original estimate furnished the supply officer, referred to above. Orders against these monthly contracts then may be made direct to the contractor, using N. M. S. Hospital Form No. 23 for this purpose. The contractor is allowed at least 24 hours' notice before delivery can be required.

For purposes of keeping stock, provisions may be classified as stock items and nonstock items.

(a) Stock items are those items of provisions, both fresh and dry, Navy Standard and Special, as are kept on hand at all times, such as all dry provisions, fresh fruits that are issued to wards daily (oranges, lemons, apples, bananas, etc.), eggs, all ordinary vegetables (potatoes, onions, lettuce, etc.), loins of beef (for steaks on short orders), hams, bacon, chicken (for special diets), bread, butter, milk, cream, etc.

(b) Nonstock items are items of fresh provisions that are ordered only when the menu calls for an article for one meal only and the particular article is not carried as a stock item.

Stock items may be carried on the medical department standard Property and Stock Card, as issued by medical supply depots. A minimum quantity of stock should be decided upon and that amount entered on the stock card. If the

cards are gone over weekly and orders placed for all items which are below the minimum quantity entered, the chance of running short of stock items is reduced to a minimum. Running short of stock items is a very common fault and one that is almost inexcusable if the system outlined above is consistently followed.

FOOD INSPECTION.

All fresh provisions received are required to be inspected by the commissary officer and the officer of the day. The inspection is made to determine whether or not the articles delivered conform to the following requirements: Agreement with the amounts ordered; delivery at the time stated in the order; in good condition at the time of delivery and in every way fit for human consumption; and in conformity in all respects with the specifications as written into the formal contract or order issued by the supply officer authorizing the transaction.

No detailed discussion of requirements and specifications will be made, but a few general rules are given, so that the fundamentals of food inspection may be available.

Meats.—All items of meats and meat food products are required by naval regulations to be inspected by an inspector of the Bureau of Animal Industry, Department of Agriculture. The meats are required to be stamped by the inspector and a certificate issued by him stating that the meats or products described on the invoice have been passed by the Department of Agriculture and that they are also in accordance with naval specifications. This certificate should be signed by the inspector.

Sex recognition.—The Navy contract specifications for fresh and various other meats excludes from acceptance meats from bulls, boars, stags, and in most cases cows. For this reason reference to the recognition of sex in the dressed carcasses has a practical value in this discussion. "The bull is characterized by the massive development of his muscles, especially the neck and shoulder musculature, also by the dark color of the musculature and the scarcity of fat tissue. Finally, the inguinal canal is open.

"The ox (steer) is distinguished from the bull by the weaker development of the shoulder and neck musculature, by its thick panniculus adiposus, and by the possession of a mass of scrotal fat tissue (cod fat) which completely conceals the inguinal ring (a positive and recognizable anatomical point in the hind quarter of all adult males is the ischio-penal ligament, which appears as a circular white fibrous patch in the posterior region of the ischio-pubic symphysis).

"The carcasses of cows are more angular in their various outlines than are those of steer carcasses. There is a marked curvature to the ribs. The cut termed 'round' is flatter; the shanks are thinner and the mass of 'cod fat' which is seen in the steer is absent in cow carcasses. Very often the udder is carefully removed from fat cow carcasses and fat skewered over the cut surface in order to give them the appearance of steers. This attempted deception, however, is easily recognized by the mammary tissue which remains and by the supramammary lymph glands covering this tissue.

"Close examination will disclose the true character of the small udder on young heifers, which, on account of heavy fat infiltration, resembles the mass of scrotal fat of steers.

"In sheep, the slaughtered buck is distinguished from the ewe and wether by the strongly developed musculature of the neck, withers, and shoulder. The meat of bucks may also possess a disagreeable odor, but, as a rule, this is rare.

"The distinction of importance as regards hogs is between boars and stags on the one hand and sows and barrows on the other. The meat of the boar is coarse and possesses a darker color and the shoulder (or shield) is extremely hard. The meat of the service boar usually has a specific odor best described as a urinous or strong sexual odor. Under the Federal meat inspection regulations, meat or carcasses having this odor are condemned as unfit for food.

"Meat which is suspected of being from a boar or from a recently castrated service boar, should be tested for odor. This test is made by placing a sample of meat or raw fat in water in a covered vessel and bringing it to a boil and testing for odor from time to time while heating, or the sample may be heated in a frying pan. In some cases the urinous or boar-sex odor will be found very pronounced and disagreeable; in others it may be faint, but whenever the odor exists to such degree that its presence can be declared the meat should be rejected as unfit for human food.

"*Characteristics of good meat.*—In all cases the carcass should be that of a well-nourished animal without signs of attenuation or wasting; good meat is firm and elastic to the touch without oedema or emphysema, that is, does not pit or crackle on pressure. It should be juicy, but not wet nor flabby; the color should be uniform without brown or discolored patches.

"Good beef is of a bright red color, marbled with fat; veal is always paler and less firm to the touch. Mutton is dullish red and firm, the fat hard and white. In both beef and mutton a uniform yellowness of the carcass may be associated with health conditions. The carcass of the pig should be plump: The flesh is naturally pale and the fat somewhat soft; the skin should not set in folds or wrinkles and should be without stains or blotches. However, slight bruises and scratches are not infrequently present in good carcasses.

"In all cases when sufficient time has elapsed for the carcass to cool and set, the fat of cattle and sheep should be firm and the suet hard, containing no watery jelly or juice, free from blood stains and creamy white or yellowish in color. The odor should be sweet and agreeable. A skewer thrust deeply into the flesh should have no unpleasant odor when withdrawn.

"The pleura and the peritoneum (the white, shiny membrane lining the chest and thoracic and abdominal cavities) should be free from adhesions and staining and free from evidence that anything has been stripped away; also particular attention should be paid to the connective tissues about the flanks, shoulders, diaphragm and region of the kidneys; signs of wetness, oedema, imperfect setting and evidence of disease in the lymph glands should be absent.

"Bull beef, it should be remembered is usually and normally dark in color, but in other cases marked darkness of the flesh is to be regarded with suspicion. (From Osterhag.)

Fresh meats defined.—The word "fresh," whenever occurring in Navy specifications for meat and meat-food products, is interpreted to include chilled fresh products which are not and have not been frozen. Conversely, products which are, or have been frozen can not be accepted as fresh. Meats that have been frozen and subsequently thawed out are dull in color and the blood from it is thin and pale in color (due to separation of the fibrin and serum upon freezing). If a specimen of the blood is mounted on a glass slide and examined under a microscope using a low-power lens the red corpuscles will present a

crinkled appearance or the edges will appear scalloped if the meat is or has been frozen.

Thawed-out poultry.—Frozen poultry that has been thawed out may be detected by the appearance of the lung tissue. If the fowl ever has been frozen the lung tissue will be dark in color and congested in appearance, but if it has never been frozen the lung will be pink in color and without the congested appearance. The lung from a fresh fowl, if slightly compressed between the fingers, will crackle (due to the air cells bursting under pressure). A thawed-out lung will not give this crackling sensation because the air cells already have been ruptured in the process of freezing.

Eggs.—Every hospital has a monthly contract for "Strictly fresh eggs." The specifications may be very definite or the description "strictly fresh" only may be used. The following discussion will be helpful to those who are not familiar with the distinguishing characteristics of a fresh egg.

Several methods of determining the freshness of eggs have been suggested in various books and pamphlets on the subject, such as placing them in water and noting the angle which they assume and whether or not they float. This method depends on the fact that in newly laid eggs the contents fill the egg, and since the specific gravity of the egg is greater than water, the egg therefore assumes a horizontal position at the bottom of the vessel when immersed. Depending on the length of time that the egg has been laid, due to evaporation of water from the contents through the porous shell, the egg assumes various angles from a horizontal position up to a vertical one. An egg that has lost sufficient moisture so that the specific gravity is less than water will float. Also an egg that has undergone decomposition to such an extent that gases have been liberated within the egg will always float.

This method has the disadvantage of being slow and inaccurate and is not always a true indication of the age of the egg. Eggs that have been placed in cold storage very soon after being laid, provided the storage rooms are kept sufficiently humid, may remain in good condition for several months without sufficient evaporation of contents to make any noticeable difference in the floating angle. On the other hand, they can not be classed as strictly fresh eggs and may have a slightly disagreeable flavor.

It is considered very desirable for every hospital to have an egg-candling device. They may be made in the hospital carpenter shop or a very satisfactory one may be purchased at little cost. One that can be used in daylight, thereby eliminating the necessity of a dark room, is the most desirable. A suitable type consists of a small sheet-steel box enclosing a 60-watt electric light. There is an opening about $1\frac{1}{2}$ inches in diameter in one side of the box, with a shield extension on the top and sides about the opening to exclude rays of daylight. The inside of the shield is painted black to prevent reflected rays from striking the opening. Through the top of the shield is an opening surrounded by another shield similar in shape to the light shield on an ordinary parlor stereoscope. By holding an egg against the small opening and looking down through the upper opening a very clear view of the contents of the egg may be had.

Any shrinkage of the egg is evidenced by an air bubble at one end. The yolk in a fresh egg will show up as a light shadow. A heavy shadow usually indicates that the egg is stale. The various degrees of staleness may be judged by the heaviness of the shadow. A rotten egg always will show black. Hatched eggs, referred to in Navy Department Specifications No. 56-E-1d, are fertile eggs that have been kept in a warm place sufficiently long after laying to start

the development of the embryo. This shows up under the candle as a small dark spot.

Broken-yolked eggs are eggs that have been kept in a warm place long enough for the capsule of the yolk to partially disintegrate and become weakened through bacterial action to such an extent that it breaks and allows the yolk to mix with the white of the egg. This condition under the candle appears as a floating shadow throughout the entire contents of the egg rather than being localized, as is the case in a normal fresh egg.

A strictly fresh egg should appear under the candle as almost entirely translucent. The only opacity should be the slight shadow cast by a normal fresh yolk. The air bubble should not be over 5 per cent of the egg contents. Eggs that do not meet these requirements should be regarded with suspicion and opened on a saucer. If, after opening, the yolk has a decidedly mottled appearance, does not stand up to almost the shape of a hemisphere, or breaks upon careful opening of the shell, the egg may be considered to be stale. The appearance of the white of the egg is also very helpful in egg inspection. In a fresh egg the white consists of two parts, a viscid, jellylike part and a thin, watery part. In storage eggs that have been held for several months and in stale eggs that never have been in storage but have been held for several days or a few weeks in a warm place the jellylike part of the white disintegrates into a thin, watery fluid.

In the inspection of eggs at a naval hospital one rarely is called upon to differentiate between fresh eggs and eggs that are distinctly rotten, but almost daily one must be able to tell the difference between strictly fresh eggs and eggs that are slightly stale. Those that are slightly stale certainly are not strictly fresh and therefore should be rejected.

At this point the student should familiarize himself with the text of the pamphlet issued by the Bureau of Supplies and Accounts, title: "General Specifications and Conditions of Delivery Applying to Provisions Contracts," dated October 1, 1921. A copy of this pamphlet should be in every commissary office. It forms a part of the specifications of all food contracts and orders.

Milk and cream.—Samples of milk and cream, both thin cream (20 per cent milk fat) and double cream (40 per cent milk fat), should be collected frequently, at least weekly, and sent to the hospital laboratory for analysis. Usually a Babcock test to determine the milk-fat content will be the only test necessary. In collecting samples of milk and cream care should be taken to collect average samples. If the milk is in cans, the milk should be poured from one can to another at least six times, so that the cream will be thoroughly mixed and evenly distributed throughout the milk, and then about a pint collected in a clean bottle as a sample. If the milk is in quart bottles, send a whole bottle to the laboratory. The same precautions should be taken in collecting samples of cream.

Fish.—The inspection of fish is difficult unless the person inspecting it is familiar with the various kinds. A study of a dictionary or a natural history that describes and gives illustrations of the different species of the fish family will prove very helpful. Cheap varieties frequently are delivered for the more expensive kinds; pollock for bluefish, flounder for baby halibut, croakers for Virginia spots, Boston mackerel for Spanish mackerel; etc. Frozen fish that has been thawed out is frequently delivered for fresh-caught fish. Fish that have been frozen lose their delicate flavor. Fresh-caught fish present the following characteristics: the gills are red; the eye is bright; the blood is bright red, and the flesh is firm. In fish that have been frozen, held in storage and subsequently thawed out, the gills are pale, the eyes dull, the blood dark

in color, and the flesh is usually soft with a slightly disagreeable color, even if it is still edible. To show the points of differentiation between fresh, stale, and putrefied fish, the following table from Meat Hygiene, by Edelman, Mohler, and Eichhorn, is given.

Condition.	Scales.	Eyes.	Gills.	Body in general and meat.	Specific gravity.
Fresh.....	Glittering, free from slime, firmly adherent.	Standing out...	Gills, lids, and mouth closed.	Solid; placing fish horizontally on the hand it does not bend. Meat firm, elastic, tight on bones.	Sink in water.
Not fresh, stale for sometime.	More or less easily removable, slightly slimy or smeary.	Red bordered, sunken; cornea cloudy.	Lids open or can be easily opened; gills pale, yellow dirty, or grayish red, covered with the same kind of fluid; odor disagreeable.	Bony, bend easily, especially at tail end; occasionally bloating of the abdomen, which may be bluish discolored. Finger impressions are easily made, and remain; meat is soft, can be easily removed from the bone.	Swim on the water.
Putrefied...	Very loose, covered with a smeary, slime-like mass of disagreeable odor.	Breaking down; are frequently removed.	Very off-colored; extremely offensive odor.	Withered, flabby, soft, pale, bloated. The meat is sloppy.	Do.

Shell fish.—In the inspection of crabs and lobsters there is but one rule to follow and that is, do not accept them unless they are alive. Ptomaines develop very quickly in crabs and lobsters. It should be remembered that the shells of dead oysters and clams are open. The juice of opened oysters and clams should be almost clear and not stringy; any stringy or milky appearance of the juice is a cause for rejection as it indicates bacterial growth. The oysters and clams should be slightly salty to the taste; a decided fresh taste indicates adulteration by "floating" or by being in direct contact with ice. Floated oysters are oysters that have been taken up from their natural beds and either laid down in fresh or brackish water, or placed in floats at the mouth of a fresh-water stream for a few weeks. When salt-water oysters are placed in fresh or brackish water the salt in the oyster tissue is dissolved out by the fresh water and the oyster becomes inflated with fresh water (due to osmosis) and increases in size so that when the bivalves are opened the oyster-man is enabled to obtain from 10 to 20 per cent more oyster meat from the same quantity of oysters in the shell, thereby increasing his profits at the expense of the innocent purchaser. Floating destroys the delicate flavor of the oyster and renders it more liable to contamination by sewage from the stream. Ice in direct contact with the oysters destroys the flavor in the same manner but does not contaminate the oyster unless the ice itself is contaminated. Clams are not generally "floated."

The inspection of fruit and vegetables will not be discussed as the standard specifications are very clear and variations from the standards are quite apparent as almost everyone can distinguish between the good, the indifferent, and the bad.

Food adulteration.—The following abstract from the Federal pure food laws will serve as a guide in the inspection of all items of foods but more particularly in the inspection of dry provisions, special, purchased direct from the contractor. All items of Navy standard dry provisions obtained on requisition from pro-

vision depots of the Navy have been inspected at the time of their original purchase by the Navy and, therefore, inspection for quantity received is the only inspection necessary when they are received at a hospital.

Adulteration of food consists in practices, some fraudulent, and others technical in nature. Some are injurious to health, but most of them have an economic rather than a sanitary significance.

Methods of adulteration:

1. The removal of nutritive substances.
2. The addition of injurious substances.
3. The fraudulent substitution of cheaper articles.
4. Misbranding.
5. The sale of food that is filthy, decomposed, or putrid.

The more common adulterations are: Cotton seed oil for olive oil; starch or sugar in cocoa and chocolate; caramel, pea meal or chicory in coffee; cheap fats or cotton seed oil in lard; saccharin for cane sugar; cereals in sausages; bran in flour; oleomargarin as butter; distilled and colored vinegar as pure cider vinegar; etc.

A food is considered adulterated, according to the Pure Food and Drugs Act of 1906:

1. If any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength.

2. If any substance has been substituted wholly or in part for the article.

3. If any valuable constituent of the article has been wholly or in part abstracted.

4. If it is mixed, colored, powdered, coated, or stained in any manner whereby damage or inferiority is concealed.

5. If it contains any poisonous or other added deleterious ingredient which may render such article injurious to health.

6. If it contains in whole or in part a filthy, decomposed, or putrid animal or vegetable substance or any portion of an animal unfit for food, whether manufactured or not, or if it is the product of a diseased animal, or one that has died otherwise than by slaughter.

7. Misbranding is regarded as a form of adulteration under the Pure Food and Drugs Act.

Food preservation.—The methods used in the preservation of foods are: Cold, drying, salting, smoking, canning, preserving, and chemical treatment.

Cold.—Cold is an antiseptic rather than a germicide. Cold temperatures kill few bacteria, but prevent the growth and multiplication of most of them. No microorganisms pathogenic to man will grow or multiply at the temperature of the refrigerator, but many saprophytic bacteria and molds will, even as low as zero centigrade. Most pathogenic bacteria withstand freezing, but suffer a quantitative reduction. Most animal parasites die in cold storage. At a temperature of 9° F. trichinae will die in 20 days. The longer an article remains in cold storage the relatively safer it is. The proper preservation temperature varies for different foods. Meat and poultry for long keeping should be kept frozen at a temperature of 25° F. To keep them for short periods in a chilled condition the temperature should be 33° F. Milk and eggs in the shell are injured by freezing. Milk keeps best at 35° F. and eggs at 32° F. Fish for long keeping usually are frozen, then dipped in water and refrozen, then stored at 20° F. This coating of ice prevents loss of water due to surface evaporation.

Articles may be kept in cold storage for a long time; fish for two years. Meat, poultry, eggs, and vegetables may be kept for months. Undrawn poultry

keeps better in cold storage than drawn, and drawn poultry decomposes more rapidly after removal from the refrigerator.

Cold imparts no new taste, nor does it seriously alter the natural flavor. It does not diminish the digestibility nor cause any loss of nutritive value.

Drying.—Drying is a primitive method of preserving meats, fruits, vegetables, and other food substances. It furnishes an ideal antiseptic condition, for bacteria require moisture for their growth, and drying removes this. Furthermore, dried foods usually are cooked before being eaten. It is not adapted as well to meats as to fruits and vegetables. Dried meats lose their natural flavor. Dried eggs and milk keep their nutritive value.

Salting and pickling.—In salting the brine should contain from 18 to 25 per cent salt. In pickling, brine, vinegar, and weak acids are used. These substances should be considered antiseptic rather than germicidal. Trichine die after prolonged pickling.

Smoking.—Smoking consists in drying the food and adding to it certain substances in the smoke, such as acetic acid, creosote, formaldehyde, etc. These are considered germicidal, but it must be remembered that the penetration is only partial; for example, in smoking sausages, if they are large in diameter, the smoke does not penetrate to the whole of the contents and they may become dangerous in regard to the various parasites and the products of decomposition contained therein, as smoked meats often are eaten raw.

Canning.—Canning consists in the application, in a practical way, of the well-known laboratory method of fractional sterilization. A second sterilization usually is made after a day or two to permit the germination of all spores, when these are killed. Canned foods are sterile and safer than the fresh article. Fortunately improperly sterilized canned foods are easily detected by the gas that will form and cause a bulging of the can, or by the odors that are produced. Canned goods are safe and quite as nutritious as the fresh article. There is great danger of contamination from the container. Erosion of the tin plate may occur, and the tin salts then are introduced into the contents. Glass containers eliminate this danger.

Preserving.—Preserving consists in the addition of sugar and cooking. For this reason the food article must be considered as free from infection. Various acids and salts are added as chemical preservatives, as salicylic acid, benzoic acid, and benzoate of soda.

Chemical preservatives.—Chemical preservatives may be considered as antiseptic substances, and not all of them are injurious to the health. There is an economic side to this question. Most people object to any chemical or drug substance being used as a preservative, but accept any substance derived from natural sources. The least harmful is benzoic acid and sodium benzoate.

The chemicals used most commonly are: Benzoic acid and sodium benzoate, borax and boric acid, formaldehyde, salicylic acid, sodium and potassium nitrate, potassium permanganate, sodium fluorid, hydrofluoric acid, sulphites, sodium bicarbonate, hydrogen peroxide, and arsenic.

ISSUE OF PROVISIONS.

The dietitian in the diet kitchen, the chief cook in the main kitchen, the housekeeper in the nurses quarters, and the person in charge of any other special mess, prepares a food requisition daily (N. M. S. Hospital Form No. 47 may be used for this purpose) and submits it to the commissary officer every morning. The requisitions are based on the menus prepared in advance, except in the case of the diet kitchen where standard menus for special diets can

rarely be used because of the constant variation in this class of diets. The requisitions should call for sufficient food for three meals—supper, and breakfast and dinner for the following day. After the requisitions are approved by the commissary officer they are sent to the issuing storeroom for issue at stated hours. The hours of issue should be arranged so that they operate to the best advantage, both to the section drawing the provisions and to the commissary department. All eggs, oranges, milk, cream, etc., issued to the wards on diet sheets should be issued by the diet kitchen and not the issuing storeroom. No uncooked food should be issued to any section or hospital department, except by the method outlined above. In other words, all food is issued through the issuing storeroom, and no food is issued from there except upon the authority of a requisition signed by the commissary officer. This permits the commissary officer to have absolute control over all issues of food.

STOCK KEEPING AND ACCOUNTING.

Naval Hospital Fund.—All provisions purchased or requisitioned from supply officers for use at naval hospitals are made a charge against the Naval Hospital Fund. (See page 603 of this book.) Whenever an enlisted man is admitted to a naval hospital or transferred to one for duty, an exchange of appropriations occurs in the Navy Department and the annual appropriation "Provisions, Navy" is debited and the naval hospital fund is credited with such an amount for each day the man is subsisted by the hospital, as is annually fixed by Congress. For the fiscal year 1924 the amount is 75 cents for patients and for all others the average cost of subsistence. Whenever an officer is subsisted in a naval hospital his pay account is checked at the fixed rate per day and this amount credited to the naval hospital fund. Whenever a staff officer of the hospital or a civilian employee wishes to purchase his meals at a hospital the same amount is checked against his pay account and made a credit to the naval hospital fund; the full rate per day if three meals are eaten or one-third the full rate if one meal per day is eaten (the purchase of two meals per day is not permitted).

The system of keeping accounts in the commissary department of naval hospitals is essentially one of daily balance of receipts and expenditures, both as to quantities of stores and the cash values thereof, with a summary of the whole at the end of each month. This gives an accurate knowledge of commissary stores on hand at all times as well as their value, shows the expenditures of any item at a glance, and with the ration memoranda affords a ready means of computing the average per diem cost of subsistence.

The receipt and expenditure voucher, N. M. S. H. Form No. 37, contains the transaction of commissary stores received and expended and the cash value thereof for one day. The entries are taken from dealers' bills and supply officers' invoices and from the rough memoranda of stores issued (on hand) from the storeroom. Stores on delivery should be accompanied by duplicate invoices, and these initialed by the officer responsible for the proper inspection and weighing of the stores. One invoice is returned to the dealer, the other filed in the dealers' jacket file of the hospital and used, as before stated, in preparing the daily receipt and expenditure voucher and also for checking dealers' bills at time of payment. The completed voucher for the day is submitted on the following morning, through the executive officer, to the commanding officer of the hospital, and upon its return a transcript of the entries thereon is made in the commissary ledger, the quantities received and expended under the respective headings and the cash value of the day's re-

ceipts and expenditures in the appropriate columns to the extreme right on the last page for the month concerned.

The commissary ledger is a loose-leaf system ledger with two distinct kinds of pages, those containing the "Cash values" columns being supplied in more limited quantity, only one of these pages being used each month, the last for the month concerned. The cash extensions for each day's transactions are here entered. A study of these pages makes their use plain. It will be noted in the commissary ledger that each item contains separate columns for the entry of receipts and expenditures, marked "R" and "E," respectively. To distinguish more clearly between the two, receipts are entered with black ink, expenditures with red ink. To prepare the commissary ledger for entries, write the name of the different articles purchased and on hand under the column "Items." Enter unit and unit price in the two columns below the item name.

On the last day of each month an inventory is taken and the amounts on hand entered under "Brought forward" for the succeeding month, calculating their value always on the actual value of the stores. When supplies are received and placed in store for issue at some future date (such items having a different unit price from those already on hand) a new unit value for the total then in store will be determined in the following manner: If on a certain date there are in store six (6) bags of corn meal worth \$1 per bag, and ten (10) more bags are received invoiced at \$2 per bag, the new issue value per bag will be \$1.625. Fill in at the end of each month columns on the bottom of the pages. Enter under "Carried over from last month" stores remaining from previous month. The amounts on line "Received this month," obtained by deducting the "Carried over from last month" column from the totals, has to correspond with the totals of dealers' or supply officer's bills. Under column "Unexpended" will appear the difference between the receipt and expenditure columns, and under column "Inventory" the actual amount on hand as found by the inventory. The difference between these two columns gives the "Loss on issue." The money value of the "Loss on issue" column plus "Total expenditures" gives the "Total cost of subsistence." Since provision vouchers are paid monthly by the hospitals, the following easy method of proving the correctness of the totals in the "Cash values" columns should be employed. To the sum total of vouchers for stores obtained during the month add the value of the stores brought forward from the previous month; this represents the absolutely correct value of receipts. If the sum so obtained differs from the sum total of the daily receipts, as it may, due to fractional differences and possible clerical errors, write under the total "Corrected totals" and the sum found in that way, using red ink. By deducting the value of stores found on hand by inventory from the above sum the absolutely correct total for expenditures will be found, and the same, if differing from the totals obtained from the totals of the daily entries, should be entered in the same way as "Corrected total." By dividing the corrected total of expenditures by the total number of rations, obtained from ration memoranda, the "Average cost of subsistence per diem" is obtained. Only provision items are to be carried in the commissary ledger.

At the end of the month the commissary officer furnishes the accounting and property officer with the total value of supplies expended during the month, classified as follows: Dairy products; meats, poultry, and fish; groceries and provisions; fruits and vegetables. He further furnishes this officer with the total value of stores on hand in order that it may be checked against the

stores account of the accounting system. The commissary ledger and that part of the stores account which represents commissary supplies must agree.

The ration return, N. M. S. H. Form No. 36, is filled in from day to day according to the changes resulting from admission and discharge of patients, transfer of hospital corpsmen, employment and discharge of civilian employees, etc. The sum total of columns 1 to 9, inclusive, less sum total of columns 10 to 14, inclusive, will give the actual number of rations issued. To find the average cost of subsistence for any given time divide the total of expenditures taken from the commissary ledger by the sum total of rations issued during the corresponding time.

In order that the Bureau of Medicine and Surgery may have current information as to the average cost per man per day for subsistence at hospitals it is required that each hospital submit, on the first of each month, a ration return prepared on N. M. S. H. Form No. 36. This report shows the total number of ration days of the following classes of persons subsisted by the hospital for the month.

Column 1.—Patient officers, Navy.

Column 2.—Patient enlisted men, Navy.

Column 3.—Patient officers, Marine Corps.

Column 4.—Patient enlisted men, Marine Corps.

Column 5.—Supernumeraries, Veterans' Bureau.

Column 5.—Supernumeraries, Employees' Compensation Commission.

Column 5.—Supernumeraries, others.

Column 6.—Hospital Corps.

Column 7.—Nurse Corps.

Column 8.—Marine Guard.

Column 9.—Civilian employees.

Column 10.—Blank.

Column 11.—Blank.

Column 12.—Total number of each class (columns 1 to 9, inclusive) who were absent with leave.

Column 13.—Total number of each class (columns 1 to 9, inclusive) who were absent without leave.

Column 14.—Total number of each class (columns 1 to 9, inclusive) who subsisted themselves.

The last column shows the actual number subsisted by classes, which is determined by subtracting the totals of columns 12, 13, and 14 for each class from the numbers shown in columns 1 to 9, respectively.

All the columns are then totaled at the foot, and the subtotal of columns 12, 13, and 14 subtracted from the subtotal of columns 1 to 9, inclusive, should equal the subtotal of the last column. This gives the total of all persons subsisted by the hospital during the month, expressed in subsistence days. To this number is added the total number of admissions of Veterans' Bureau patients during the month. In the case of Veterans' Bureau patients both the day of admission and the day of discharge are counted as subsistence days, which is not true for any other class of persons subsisted. This gives the grand total of actual number of subsistence days for the month.

The "total cost of subsistence" (obtained from the commissary ledger) divided by the grand total of actual number of subsistence days, gives the average cost of subsistence per diem for the month.

Payment of monthly bills.—At the end of each month each firm that has furnished provisions during the month furnishes the hospital with an invoice in triplicate showing the quantity, unit price, and value of each item of provisions purchased and the total value of all items furnished. The clause "Certified correct and just, payment not received" is written across the face of the invoice and signed by a member or official of the firm, giving his

title. When these invoices are received they are checked carefully against the total quantities received and recorded in the commissary ledger and against the copy of the contract on file as regards units of quantity and price and for errors in extension and addition of extensions. Fractions of cents in excess of 5 mills are allowed the contractor, fractions less than 5 mills are dropped. If any errors are found in the invoices they should be returned to the contractor with a letter pointing out the errors found and requesting corrected invoices. However, the words corrected invoice or similar phases should not appear on the final invoice rendered. Invoices so marked will not be passed for payment by the Navy Department.

Public bills.—When a correct invoice has been received a public bill (on shore) Medicine and Surgery Form No. 5 is made out, original and seven copies. One copy is filed, together with a copy of the contractor's invoice. The original and six copies, together with the original and one copy of the contractor's invoice, is forwarded to the local supply officer for approval and recording. He then forwards the public bill to the local disbursing officer, who actually pays the bill by forwarding a check for the amount of the bill to the contractor who originally presented it.

Provisions invoiced by supply officers.—Provisions obtained from Navy provision depots or the supply departments of navy yards on requisition, Supplies and Accounts Form No. 30, are followed up by an "Expenditure" invoice (Supplies and Accounts Form No. 71) in quadruplicate. When the provisions have been received and the invoice checked the original and one copy is signed by the commanding officer and returned to the supply officer who issued the provisions. When this transaction has been completed the accomplished invoice becomes a charge against the hospital in the same manner as a purchase against a contract with a private firm.

COMMISSARY FILES.

Dealers' jacket file.—The dealers' jacket file is a series of envelope jackets with the name of each firm from which provisions are purchased on the jacket. The jackets are filed alphabetically, using the initial letter of the first name appearing in the firm's name as the key letter, thus: The name Smith, Browne & Co., would be filed under the key letter "S." In each jacket is filed a copy of all order and inspection blanks (N. M. S. H. Form No. 23) for provisions to firms holding provision contracts during the current month. In each firm's jacket is filed the retained copy of all daily delivery invoices receipted for during the month. When a correct monthly invoice has been received from the firm the retained copies of all "order and inspection blanks" are taken out of the dealers' jacket file and totaled and checked against the monthly invoice. When the public bill in payment of the monthly invoice has been prepared the retained copy of the public bill and all copies of the orders for the month are clipped together, marked with the month and year to which they pertain, and permanently filed in the dealer's individual jacket. A copy of all correspondence with firms in reference to provision orders or contracts is filed in the dealers' jacket file.

Provision requisition file.—A file copy of each provision requisition on provision depots or navy yard supply departments is retained in a separate file. The requisitions are numbered serially throughout a fiscal year. All correspondence in reference to a shipment of provisions is filed with the retained copy of the requisition to which it pertains. The copy of the accomplished invoice and a copy of the bill of lading on which the stores were shipped is also filed with the copy of the requisition.

Ration memoranda file.—A separate file is maintained in which are filed copies of all monthly ration memoranda (N. M. S. H. Form No. 36) forwarded to the Bureau of Medicine and Surgery above described. Copies of these reports are filed chronologically according to months.

Stock card file.—A stock card file is kept of all stock items, indexed alphabetically. The medical department "Property and Stock Card" may be used and is recommended. All issues from the dry provision storeroom are deducted from the amounts on hand and all receipts of stock items are added thereto, giving dates, etc., as indicated on the cards.

The above-mentioned four files are the only ones necessary to keep in a commissary office.

DUTIES OF COMMISSARY DEPARTMENT PERSONNEL.

Commissary officer.—The commissary officer, a chief pharmacist or pharmacist, is responsible for: (1) The purchase of all provisions received by a naval hospital for use in any of its various departments and for the preparation and serving of food for the general mess; (2) the care of provisions and the judicious expenditure of funds for their purchase; (3) the organization and efficient functioning of the commissary department; (4) keeping the accounts of the commissary department and administering all its affairs; (5) general supervision over all persons employed in the service of the general mess; and (6) for the accounting of all articles of property and equipment in the commissary department. He should inspect the storerooms frequently to see that the provision stores are properly stowed and the storerooms dry, clean, and well ventilated. Deterioration in stores being a direct loss to the mess, great care must be exercised in their selection, and no greater quantity bought at one time than may be expected to keep in good condition. The commissary officer should inspect all provisions received, in person, and notify the officer of the day of all stores received, and report to him whenever any rejections are made for nonconformance with the specifications, so that an entry to that effect may be made in the Medical Journal. He should cause the commissary steward to keep a stock account of all provision stores on hand that have not been expended. From time to time he should make recommendations to the executive officer, with the idea of promoting efficiency or economy, and whenever the interests of the commissary department require any change which he himself is not authorized to make. He should report flagrant cases of incompetency among the personnel under his supervision, either civilian employees or enlisted men, to the executive officer for such disciplinary action as may be necessary. In addition to the above, the commissary officer, while not in any way responsible for the operation of the nurses' or sick officers' messes, or the diet kitchen, or the preparation or serving of food therein, observes the carrying on of work in these activities and makes such recommendations or suggestions for improvement, economy, or correction of faults as he may consider necessary to the person or persons in charge or the executive officer, as the conditions warrant.

Commissary steward.—The commissary steward (usually a chief pharmacist's mate) is the chief petty officer in charge, under the commissary officer, of the general mess. He is entitled to respect and obedience from all persons of inferior rating and from civilian employees in the department while in the performance of his duties. He is responsible for the proper execution of the orders of the commissary officer and may be called on to prepare the weekly menu for the approval of the commissary officer. He has general supervision over the storekeepers and storerooms, main kitchen, and mess halls. He pays

particular attention to garbage collection and food waste, reporting any excesses to the commissary officer. He supervises the issue of all foods and the serving of the food in the general mess halls. When provisions are received he should be present to assist in the inspection and weighing and should take charge of the provisions accepted and see that they are properly stowed and accounted for. He personally should keep the stock cards of provisions on charge in the dry provision storeroom and make estimates of provisions required so that orders or requisitions may be prepared by the clerk for the signature of the commissary and executive officers. He prepares the "Receipt and Expenditure Voucher" daily, or furnishes the data from which the clerk may prepare it. In the absence of the commissary officer the commissary steward assumes the duties of the former.

Clerk.—The commissary clerk (usually a pharmacist's mate) is held responsible to the commissary officer for making the proper entries in the commissary ledger; the preparation of orders and requisitions for provisions; the checking of monthly dealers' invoices and preparation of public bills in payment thereof; accomplishing provision invoices from provision depots; filing; and the typewriting of all correspondence incident to the commissary department. He may be required to prepare the smooth Receipt and Expenditure Vouchers daily and to perform such other special or routine work as may be assigned him.

Storeroom keepers.—The duties of the storekeepers (usually pharmacist's mates) are as follows: Have alternate day's duty in the commissary department; make all issues of provisions from the issuing storerooms on requisitions approved by the commissary officer only; keep the storerooms clean and orderly; prepare lists of provisions necessary to restock the issuing storeroom shelves from the dry provision storeroom for approval by the commissary steward. Keeps the commissary steward informed daily of the nonstock items on hand by daily inventory.

Chief cook.—The chief cook is in immediate charge of the main kitchen in large hospitals and acts in the capacity of a chef in a hotel. He is held strictly responsible for the cleanliness of the kitchen and accessory rooms and the utensils and equipment pertaining to them; for the maintenance of discipline and personal cleanliness of his assistants; for the proper preparation of food requisitions for the issuing storeroom; for the proper preparation and cooking of the food; and for having the meals ready at the prescribed hours. He should pay particular attention to all articles of food that have been cooked in excess of actual requirements and see that they are recovered and properly preserved for future use. He should keep the commissary steward informed as to the amounts of such articles, so that the menu may be arranged to include them. The chief cook supervises the work of all cooks, bakers, and mess attendants connected with the main kitchen of the hospital. He supervises the mess attendant who acts in the capacity of yardman.

First cooks.—First cooks, under supervision in large hospital kitchens, prepare and cook food, or in a smaller hospital have entire supervision of the kitchen and bakery service; requisition food and kitchen supplies; supervise employees assisting in the preparation of food and in cleaning the kitchen, accessory rooms, and equipment; and perform related work as required.

Second cooks.—Second cooks, under immediate supervision in a hospital kitchen, assist in the preparation and cooking of the food; direct and work with other employees engaged in the care and preparation of food for cooking; assist in cleaning the kitchen, accessory rooms, and equipment; serve the cooked food from the kitchen; and perform such related work as may be required.

Bakers.—Bakers, under general supervision, make bread, cakes, and pastry; work with and direct employees engaged in baking; clean and care for the bakery and its equipment; requisition and account for bakery supplies; and perform such related work as may be required.

Mess hall masters-at-arms.—The mess hall masters-at-arms (usually pharmacist's mates) are responsible for the maintenance of discipline in their respective mess halls during meal hours; direct patients, hospital corpsmen, civilian employees and others to the proper mess halls; receive complaints and report the same to the commissary officer; assist the storeroom keepers in the handling, stowage, or issuance of provisions; and perform such other special or routine work as may be assigned them.

Chief mess attendants.—Chief mess attendants, under supervision, direct and supervise employees, or patients, engaged in serving food in mess halls, dormitories, and wards, or in ordinary culinary work in connection with the serving of food. They are responsible for the appearance and cleanliness of the mess halls, their equipment, and furnishings. They perform such additional related work as may be required.

Mess attendants.—Mess attendants, under immediate supervision, perform ordinary culinary work in a kitchen, pantry, or mess hall, such as washing and drying dishes, cleaning and polishing metal utensils, cutlery, and silverware; scrubbing floors; washing walls, windows and woodwork; assisting in the preparation of vegetables and other food for cooking; serving meals in mess halls, dormitories, and wards; cleaning mess halls and equipment; act as yardmen out of doors in the rear of the kitchen and as such keep the garbage cans and rear of the kitchen in a clean and sanitary condition; and perform related work as may be required.

Meat cutter.—The meat cutter, under supervision, cuts up and prepares meats, fish, and poultry for cooking; works with and directs other employees engaged in meat cutting; requisitions, inspects, stores, and issues such supplies as may be required; cleans and keeps in a sanitary condition and is held responsible for the meat room, tools, refrigerators, and other equipment; and performs related work as required.

Pantrymen.—The pantrymen are civilian employees who work in the same capacity and perform the same duties as the storekeepers, before mentioned, whenever for any reason hospital corpsmen are not detailed for this duty.

THE COMMISSARY DEPARTMENT IN NAVY BASE HOSPITALS.³

As has been seen in the description of Navy base hospitals on page 611, the personnel of the commissary department consists of enlisted men under the supervision of the commissary officer. For a 500-bed Navy base hospital the organization in general may be as follows.

The commissary officer is a chief pharmacist or pharmacist and his duties are in effect the same as in a naval hospital. The commissary clerk, usually a pharmacist's mate, has duties similar to those previously shown as being performed by him.

Directly under the supervision of the commissary officer is the chief commissary steward who is responsible for the assignment of the other personnel to their respective duties, the arrangement of watch and liberty lists, the preparation and service of food, the cleanliness and upkeep of all galley, bakeshop, and mess equipment and the maintenance of stocks of dry and fresh provisions as well as their procurement.

³ Prepared by Chief Pharmacist N. L. Saunders, United States Navy.

A ship's cook, first class, is assigned duty as chief cook. In addition to being in actual charge of the galley and bakeshop, his duties are very similar to those of a chief cook as previously described in this chapter.

The duties of the butcher, usually a ship's cook, second class, are the same as those given for the meat cutter.

The commissary steward, chief cook, and butcher are on duty every day, but the remaining ship's cooks and the mess attendants are divided into watches. The watch for cooks begins at 1 p. m. on alternate days and in each watch are one ship's cook, first class, who is in charge of the watch, two ship's cooks, second class, known as the meat and vegetable cooks, and charged with the preparation of those items of the menu, and two ship's cooks, third class, who assist the other cooks in the preparation of food and perform such other duties as may be assigned them. Each watch is responsible for the cleanness of the galley and adjoining rooms, and the general duties of the members of the watch may be considered to be as described above.

The bakers, one baker, first class, and one baker, second class, are in charge of the bake shop, if there be one, and their duties in general have been described before. They are not assigned to watches, as the nature of their duties usually requires them to be present on duty every day.

Mess attendants are divided into watches for purposes of liberty only, their duties, which are the same as shown before in this chapter, requiring them to be present for every meal, and it being desirable to have some always available for the emergent serving of food.

Owing to the character of duty performed by a Navy base hospital, the possible necessity and desire of officer personnel to maintain individual messes, the greater ease with which supply officers often can obtain supplies, and the authority of supply officers to sell to officers' messes, it may be desirable to depart somewhat from the usual method of conducting the accounting system for commissary stores and equipment. A system similar to the one shown below, but necessarily dependent upon local conditions, may be used satisfactorily.

The supply officer purchases and accounts for all provisions, and equipment other than the initial outfit, obtained in emergency. The commissary ledger is used for a record of all receipts and expenditures of provisions, and books are opened for keeping a record of sales of provisions to messes and the receipt of new equipment not received on medical department requisitions. The ration memorandum is kept as directed in the Manual of the Medical Department, but the receipt and expenditure voucher may not be used, or, if used, should contain under expenditures only those items actually used by the hospital.

On the last calendar day of the month an inventory of all stores on hand is taken and should show both the quantity and value of each item thereon. The sales to messes are totaled and added to the inventory and the sum of both subtracted from the total quantity and value of the inventory for the preceding month plus the receipts during the current month. The answers obtained by this subtraction are the quantity and value of the provisions actually used by the hospital.

The supply officer then prepares an itemized expenditure invoice (S. & A. Form No. 71) covering these items of provisions, and the commanding officer acknowledges their receipt thereon. Equipment purchased by the supply officer is transferred to the medical department in a similar manner.

It is not expected that purchase of equipment by the supply officer will be made when it is possible to prepare requisitions for the same in the regular manner.

INDEX.

	Page.		Page.
Abbreviations on prescriptions.....	404	Acidimetry and alkalimetry:	
Abdomen:		Alkali.....	377
Acute conditions of.....	93	Indicator.....	377
Wounds of.....	71	Titration.....	377, 378
Abdominal massage.....	195	Volumetric solutions.....	377
Abducens nerves.....	47	Aconite.....	474
Abduction, joint.....	15	Poisoning by.....	491
Ablution.....	206	Tincture of.....	474
Abscess:		Addiction, drug.....	483
Inguinal glands (venereal).....	345	Detection of.....	485
Treatment of.....	58	Diagnosis.....	486
Absorption, in digestion.....	32	Symptoms of.....	485
Acacia (gum arabic).....	462	Treatment for.....	487
Accessories, X-ray.....	551	Addicts, drug:	
Accommodation.....	51	Classes of.....	485
Astigmatism.....	51	Number of.....	484
Defects of.....	51	Addison's disease.....	38
Hypermetropia.....	51	Addresses, bureaux or offices.....	621
Myopia.....	51	Adduction, joint.....	15
Presbyopia.....	51	Adeps (lard).....	460
Accounting:		Adhesion, definition of.....	356
Medical department.....	634	Adhesive plaster.....	171
Property officer.....	634	Administration of medicines.....	410
Stock keeping and.....	674	By inhalation.....	411
Accounting system:		By inunction.....	411
Expense analysis statement.....	636	By mouth.....	411
Journal.....	636	By rectum.....	411
Ledgers.....	636, 637	Hypodermoclysis.....	411
Registers.....	636	Intramuscularly.....	411
Acetanilid.....	448	Intravascularly.....	411
Acetphenetidin.....	449	Modes of.....	411
Acetylsalicylic acid.....	450	Rules for.....	411
Acid-s.....	402	Subcutaneously.....	411
Acetic, glacial.....	449	Administration of naval hospitals.....	608
Acetylsalicylic.....	450	Adulteration, food.....	671
Boric.....	417	Aedes mosquito.....	519
Carbolic (phenol).....	446	Aération of blood.....	32
Citric.....	449	Aërobes.....	503
Hydrochloric.....	415	Aërobic bacteria.....	65
Hydrogen.....	368	Aëronautics, Bureau of.....	590
Inorganic.....	415	Agar, medium.....	502
Table of.....	381	Agglutinins.....	507, 509, 510
Mineral.....	415	Aid stations, expeditionary force.....	541
Molecule of.....	368	Air:	
Nitric.....	416	Atmospheric pressure.....	277
Organic, and their esters.....	449	Carbon dioxide in.....	276
Oxy—		Chemical constituents of.....	276
Table of.....	381	Composition of.....	275
Phenylcinchoninic.....	451	Microorganisms in.....	278
Phosphorous.....	371	Nitrogen in.....	276
Picric.....	447	Physical properties of.....	276
Salicylic.....	450	Poisonous gases in.....	278
Strength of.....	368	Relation to health.....	275
Sulphuric.....	416	Albumin, presence in urine.....	523
Aromatic.....	417	Alcohol-s:	
Tannic.....	450	Definition of.....	442
Tartaric.....	451	Dehydrated.....	443
Ternary, table of.....	381	Dilute.....	443
		Ethyl, poisoning by.....	492

Alcohol-s—Continued.	Page.	Anæsthesia—Continued.	Page.
For sterilization.....	169	Respiration of patient in.....	181
Glycerin.....	443	Specialists in.....	179
Methyl.....	443	Spinal.....	191
Poisoning by.....	492	Stovaine.....	192
Procuring of.....	633	Table for anæsthetist.....	182
U. S. P.....	442	Treatment of emergencies in.....	188
Alcoholism, unconsciousness caused by.....	92	Tropococaine.....	192
Aldehydes:		Anæsthetic-s.....	407
Definition of.....	443	Agents.....	182
Formaldehyde, solution of.....	444	Administration of.....	178
Hydrated chloral.....	444	Chloroform.....	185
Alexin, blood.....	510	Combinations of.....	187
Alimentary tract.....	39	Ether.....	183
Alimentation, duodenal.....	229	Ethyl chloride.....	187
Alkali-es.....	402, 417	Nitrous oxide.....	187
Chemical action of.....	377	Drug addiction.....	483
Elements.....	374	Local.....	190
Alkaline earths.....	374, 427	Anæsthetist:	
Alkaloidal:		Equipment for.....	181
Drugs.....	467	Responsibilities of.....	179
Salts.....	467	Anæsthetizing room, equipment of.....	165
Alkaloids.....	402, 467	Analgesia (<i>See</i> Anæsthesia).	
Allotropic modifications.....	374	Analgesics.....	407, 477
Aloes.....	461	Local.....	477
Alteratives.....	407	Analysis:	
Alum.....	430	Blood.....	521
Aluminium:		Chemical.....	354
Alum.....	430	Water.....	288
Cataplasm of kaolin.....	431	Anaphrodisiacs.....	407
Compounds of.....	430	Anaphylactic shock.....	508, 509
Ambocaptor-s.....	510	Anaphylaxis.....	508
Paper, procuring of.....	633	Anatomy:	
Ambulance company, regimental medical detachment.....	542	Comparative.....	5
Ambulance party.....	533	Definition of.....	5
Ammonia:		Microscopical.....	5
Aromatic spirit of.....	427	Anhydrotics.....	407
Water.....	396	Ankle bones.....	14
Stronger.....	426	Annual contract, Bureau of Yards and Docks.....	633
Ammoniated mercury.....	437	Anode terminals.....	545
Ammonium.....	380	Anodynes.....	407
Carbonate.....	427	Local.....	477
Chloride.....	426	Anopheles mosquito.....	519
Ammunition depots.....	596	Antacids.....	407, 478
Amorphous.....	374	Anthelmintics.....	407, 479
Amyl nitrite.....	451	Antibodies.....	507
Amylopsin.....	37	Antidotes.....	407, 491
Anæmia, diet in.....	230	Antiemetics.....	407
Anaërobies.....	503	Antigen:	
Anaërobic bacteria.....	65	Procuring of.....	633
Anæsthesia:		Antimony:	
Agents used in.....	182	And potassium tartrate.....	433
Care of patients.....	174, 179	Compounds of.....	433
After operation.....	188	Antiperiodics.....	407
Cocaine.....	190	Antiphlogistics.....	407
Definition of term.....	178	Antipyretics.....	407
Equipment for administering.....	181	Antipyrine.....	448
Eucaine.....	190	Antiseptic-s.....	167, 408, 477, 478, 482
General.....	178, 180	Dressing.....	66
Administration of.....	183	Antisialics.....	408
Local.....	178, 190	Antispasmodics.....	408
Preparation of patient.....	191	Antisymphilitics.....	408
Novocaine.....	190, 191, 192	Antitoxins.....	507
Preparation of patient.....	180	Aorta.....	26
Procaine.....	190	Arch of.....	26
Quinine and urea hydrochloride.....	190, 191	Ascending.....	26
		Descending.....	26

Aorta—Continued.		Artery-ies—Continued.	
Description of.....	26	Ulnar.....	26
Thoracic.....	26	Visceral group.....	27
Aperient-s.....	408	Arthology , definition of.....	6
Aphrodisiacs.....	408	Arthropoda.....	517
Apnoea.....	32	Artificial respiration.....	89
Apomorphine hydrochloride.....	470	Ascaris lumbricoides.....	515
Apoplexy.....	92	Asepsis in operating room.....	166
Appendicitis, acute.....	94	Aseptic dressing.....	66
Appointment:		Asiphonate mosquito.....	519
Dental officers.....	607	Asphyxia.....	32, 88
Medical officers.....	607	Aspirin.....	450
Nurses.....	607	Assistant Secretary of the Navy.....	583
Of chief pharmacists.....	608	Astigmatism.....	51
Of pharmacists.....	608	Astringents.....	408, 477, 482
Appropriations, annual:		Atmospheric pressure, effects of.....	277, 278
Bringing home remains of officers, etc....	603	Atomic:	
Care of Hospital Patients.....	603	Weight.....	356
Contingent, Bureau of Medicine and		Weights, table of.....	379
Surgery.....	602	Atoms.....	355
Medical Department.....	602	Atropine, poisoning by.....	492
Naval Hospital Fund.....	603	Atropine sulphate.....	471
Numbers of.....	604	Auditory nerves.....	47
Salaries, Navy Department.....	603	Autoclave.....	168
Aqueous humor.....	50	Autocondensation.....	221
Arachnoids.....	517	Autogenous vaccines.....	510
Arithmetic, pharmaceutical.....	388	Autotransformer, X-ray.....	547
Aromatic-s.....	408	Autopsy.....	570
Bitters.....	408	Avogadro, law of.....	375
Sulphuric acid.....	417	Axones.....	43
Arsphenamine.....	432	Bacilli.....	503
Treatment of syphilis.....	336	Bacillus:	
Arsenic:		Aërogenes capsulatus.....	167
Arsphenamine.....	432	Anthraxis.....	167
Compounds of.....	432	Coli communis.....	167
Neosarsphenamine.....	432	Mallei.....	167
Neosalvarsan.....	432	Tetani.....	167
Poisoning by.....	492	Tuberculosis.....	167
Potassium arsenite, solution of.....	432	Bacteria:	
Salvarsan.....	432	Aërobes.....	503
Arterial:		Anaërobes.....	503
Bleeding from lips.....	63	Bacilli.....	503
Hæmorrhage.....	61	Cocci.....	503
Arm, forearm, or hand.....	63	Nonpathogenic.....	503
Armpit.....	63	Pathogenic.....	503
Face.....	63	Pneumococcus.....	167
Neck.....	63	Pyogenic.....	167
Thigh, leg, or foot.....	63	Spirilla.....	503
Artery-ies:		Staphylococcus.....	167
Aorta.....	26	Streptococcus.....	167
Celiac axis.....	27	Bacterial:	
Common carotid.....	26	Cultures, emulsions, procuring of.....	633
Common iliac.....	28	Vaccines.....	510
Coronary.....	26	Bacteriology	501
Description of.....	24	Definition of.....	383
External carotid.....	26	Stains used in.....	503
Inferior mesenteric.....	27	Bacteriolysins	507
Inferior phrenic.....	27	Bacon as food.....	227
Innominate.....	26	Balance-s	386
Internal carotid.....	26	Compound lever.....	387
Lumbar.....	28	Double beam.....	387
Middle sacral.....	28	Single beam.....	386
Parietal group.....	27	Torsion.....	387
Spermatic.....	27	Balanitis	331
Subclavian.....	26	Balantidium coli	512
Superior mesenteric.....	27	Balsam-s	457
Suprarenal.....	27	Of Peru.....	458

	Page.		Page.
Bandage-s.....	98	Bath-s—Continued.....	
Application of.....	101	Starch.....	160
Barton.....	106	Sulphur.....	160
Circular.....	101	Temperature of.....	157
Complete, of hand.....	103	Towel.....	206
Demigauntlet.....	103	Tub.....	158
Double "T".....	108	Uses of.....	157
Extremity.....	100	Whirlpool.....	211
Eye.....	107	Battalion, ship's.....	533
Figure of eight.....	102, 103	Bed-s:	
Foot.....	105	Ether.....	135
Gauntlet.....	103	Fracture.....	135
Lower extremity.....	104	Making.....	134
Many-tailed.....	108	Wards.....	117, 120
Materials used for.....	99	Bedbugs, elimination of.....	274
Oblique.....	101	Beef:	
Plaster of Paris.....	108	As food.....	227
Recurrent.....	101	Cuts of.....	663
Recurrent of head.....	106	Belladonna:	
Roller.....	99	Leaves.....	472
Removal.....	100	Extract of.....	472
Sayre dressing.....	107	Ointment.....	402
Spica of foot.....	104	Plaster.....	471
Spica of groin.....	104	Poisoning by.....	492
Spica of right shoulder.....	104	Benedict's test.....	523
Spiral.....	101	Benzoïn, compound tincture of.....	458
Spiral reverse.....	102	Benzyl:	
Starched.....	109	Benzoate.....	452
"T".....	108	Bromide gas.....	557
Triangular.....	109	Behzylis benzoas.....	452
Types of.....	99	Beriberi.....	285
Use in surgery.....	171	Bichloride of mercury.....	435
Velpeau.....	105	Disinfectant.....	267
Bandaging.....	98	Poisoning by.....	493
General rules for.....	99	Sterilization by.....	169
Barium.....	427	Bier's cup.....	132
Dioxide.....	429	Bile:	
Barton bandage.....	106	Description of.....	35
Base-s:		Duct.....	35
Chemical.....	371	Binary compounds.....	361
Hospital, commissary department—		Bismark brown stain.....	503
Organization of.....	680	Bismuth:	
Personnel of.....	680	Subgallate.....	433
Metals.....	374	Subnitrate.....	433
Basic salts.....	371	Bitters.....	478
Basophiles.....	21	Aromatic.....	408
Bath-s:		Simple.....	408
Bed, preparation for.....	157	Bladder irrigation.....	153
Bicarbonate of soda.....	160	Blaud's pills.....	432
Bran.....	160	Bleeding from scalp.....	63
Brand.....	207	Blisters.....	132
Classes of.....	157	Blood:	
Cleansing.....	157	Aëration of.....	32
Cold.....	158	Analysis.....	521
Application of.....	158	Cells.....	20
Friction.....	207	Basophiles.....	21
Collapse during.....	158	Eosinophiles.....	21
Electric light.....	214	Leucocytes.....	20
Foot.....	159	Neutrophiles.....	21
Hammock or continuous.....	209	Polymorphonuclear leucocytes.....	21
Hot.....	159	Chemistry and urinalysis.....	521
Medicated.....	160	Circulation of.....	25
Method of giving.....	160	Coagulation.....	22
Operative cases.....	149	Complement.....	510
Salt glow.....	160	Composition of.....	19
Sheet.....	206	Corpuscles, white.....	20
Sitz.....	160		

Blood—Continued.	Page.	Bone-s—Continued.	Page.
Count:		Occipital.....	9
Complete.....	505	Of hand.....	12
Differential.....	505	Head.....	9
Method of making.....	505	Lower extremity.....	13
Cultures.....	506	Sternum.....	10
Description of.....	19	Thorax.....	10
Fibrinogen.....	21	Trunk.....	10
Functions of.....	19, 521	Upper extremity.....	11
Hæmoglobin.....	20	Olecranon process.....	12
Hæmolytic.....	22	Os coxæ (hip bone).....	13
Lymph, definition of.....	22	Ossa carpi.....	12
Lymphocytes.....	20	Palates.....	9
Method of procuring specimen.....	521	Parietal.....	9
Paraglobulin.....	21	Patella (knee cap).....	14
Phagocytosis.....	20	Pelvis.....	13
Plasma.....	21	Periosteum.....	7
Platelets.....	21	Phalanges.....	12
Pressure.....	25	Process, defined.....	8
Prothrombin.....	22	Pubic.....	13
Pulse pressure.....	26	Radius.....	12
Red cells.....	20	Ribs.....	10
Sero-albumin.....	21	Scapula.....	11
Stain, procuring of.....	633	Sphenoid.....	9
Thrombin.....	22	Spine.....	8
Vascular system, organs of.....	23	Stapes.....	9
Work:		Styloid process.....	12
Blood count.....	505	Symphysis pubis.....	13
Cultures.....	506	Talus.....	14
Smears.....	504	Tarsal.....	14
Syphilis, detection of (Wassermann reaction).....	506	Temporal.....	9
Blue mass.....	434	Tibia (shin bone).....	14
Boil or furuncle.....	58	Tubercle.....	8
Bone-s:		Tuberosity.....	8
Acetabulum.....	13	Turbinates.....	9
Calcaneus.....	13, 14	Ulna.....	12
Classification of.....	8	Vertebrae.....	10
Clavicle.....	11	Vomer.....	9
Condyle.....	8	Zygomatic.....	9
Coronoid process.....	12	Borax, use in cold cream.....	402
Cranium.....	9	Boric acid.....	417
Crest.....	8	Solution.....	169
Cuboid.....	13	Borrelia recurrentis.....	512
Cuneiform.....	13	duttoni.....	512
Definition of.....	6	Botany, definition of.....	383
Development of.....	7	Bottles and vials, for mailing, procuring of.....	633
Ethmoid.....	9	Bowels, care of.....	296
Femur (thigh bone).....	13	Boyle's law.....	376
Fibula (calf bone).....	14	Brain:	
Frontal.....	9	Arachnoid, the.....	45
Head.....	8	Cerebellum.....	45
Hip bone.....	13	Cerebrum.....	45
Humerus.....	11	Compression of.....	92
Hyoid.....	8	Concussion of.....	91
Ilium.....	13	Description of.....	44
Incus.....	9	Divisions of.....	45
Ischium.....	13	Dura mater.....	44
Lachrymal.....	9	Fissures.....	46
Malar.....	9	Medulla oblongata.....	46
Malleus.....	9	Pia mater.....	44
Mandible.....	9	Pons Varolli.....	45
Marrow.....	6	Brand bath.....	207
Metacarpal.....	12	Bright's disease.....	92
Metatarsal.....	14	Bringing home remains of officers, etc., appropriation.....	603
Nasal.....	9	Brittleness, definition of.....	355
Navicular.....	13	Bromine.....	411

	Page.		Page.
Brom-benzyl cyanide gas.....	557, 559	Carbohydrates.....	223
Bronchi.....	30	Disaccharides.....	224
Bronchitis, acute.....	143	Monosaccharides.....	224
Brown mixture.....	462	Polysaccharides.....	224
Bruise.....	71	Carbol fuchsin stain.....	503
Buccal cavity.....	32	Carbon dioxide, in air.....	276
Buchu, fluidextract of.....	456	Carbon monoxide gas.....	557, 562
Bureau-s, Navy Department.....	583	Carbonization.....	390
Of Aeronautics.....	590	Carbuncle.....	58
Construction and Repair.....	587	Cardamom, compound tincture of.....	453
Engineering.....	588	Cardiac:	
Medicine and Surgery.....	588	Depressants.....	408
Appropriations, annual.....	601	Stimulants.....	408
Chiefs of.....	600	Care and cleaning of wards.....	118
Dispensary, Naval.....	607	Care of hospital patients, appropriation.....	603
Divisions of.....	605	Carminatives.....	408, 478
Duties of.....	588, 589, 600	Carrier, communicable disease.....	238
Finances of.....	601	Cascara sagrada, extract of.....	465
History of.....	598	Aromatic fluidextract of.....	465
Naval hospitals.....	601	Cassette, X-ray.....	551
Organization of.....	604	Castor oil.....	459
School, Naval Medical.....	607	Cataplasms of kaolin.....	431
Surgeons general.....	600	Cathartics.....	408
Navigation.....	585	Aperients.....	408
Ordnance.....	587	Cholagogues.....	408
Supplies and Accounts.....	589	Hydrogogues.....	408
Yards and Docks.....	586	Laxatives.....	408
Burns and scalds.....	84	Purgatives—	
Treatment of.....	85	Drastic.....	408
Caffeine sodio-benzoate.....	476	Saline.....	408
Caffeine, citrated.....	476	Simple.....	408
Caisson disease.....	277	Catheterization.....	153
Calcination.....	390	Cathode terminals.....	545
Calcium.....	427	Caustic alkalies, poisoning by.....	493
In foods.....	226	Caustics.....	408, 477
Oxide.....	428	Cell-s:	
Caloric values.....	654	Blood.....	20
Calorie:		Columnar.....	6
Definition of.....	225	Chromatin.....	5
Camp:		Cytoplasm.....	5
Site, selection of.....	323	Definition of.....	5
Waste—		Epithelial.....	6
Disposal of.....	313	Neuro-epithelial.....	6
Horse litter.....	317	Nucleus.....	5
Liquid.....	316	Protoplasm.....	5
Water supply in.....	290	Specialized.....	6
Camphor.....	454	Squamous.....	6
Liniment.....	397	Cementum.....	110
Camphorated tincture of opium.....	469	Centigrade scale.....	390
Canaliculi.....	49	Cerates.....	400
Canning of food.....	673	Cereals as food.....	228
Canteens, care of.....	313	Cerebellum.....	45
Cantharidal collodion.....	467	Cerebral:	
Cantharides.....	467	Depressants.....	408
Capillaries, description of.....	24	Excitants.....	408
Capsicum:		Nerves.....	47
Plaster.....	456	Cerebrospinal:	
Tincture of.....	456	Fever.....	240
Carbolic acid.....	446	Nervous system.....	43
Disinfectant.....	267	Cerebrum.....	45
Poisoning by.....	495	Cestodes.....	513
Sterilization by.....	169	Chalk, prepared.....	429
Carbonate radicle.....	369	Chancre:	
		Extragenital.....	334
		Genital.....	334

	Page.		Page.
Chancreoid.....	257	Chemistry—Continued.....	
Abscess, inguinal glands.....	345	Mass.....	355
Appearance of.....	343	Matter, definition of.....	354
Infection by.....	343	Molecular weight.....	357
Treatment of.....	344	Molecules.....	355
Characteristics of:		Newton's law.....	355
Perspiration.....	39	Nomenclature.....	360
Urine.....	39	Polyvalence.....	359
Charles' law.....	376	Salts.....	371, 381
Chart, clinical.....	123	Synthesis.....	354
Chemical:		Tenacity.....	355
Affinity, definition of.....	356	Valence.....	358
Change.....	353	Weights, atomic, table of.....	379
Compound.....	353, 354	Chicken pox.....	141, 261
Formulas.....	357	Chief pharmacists, appointment of.....	608
Incompatibility.....	405	Chief of Naval Operations, duties of.....	583
Notation.....	357	Chief warrant officers.....	592
Preparations.....	395	Chiefs of Bureau of Medicine and Surgery.....	600
Preservatives of food.....	673	Chilblain.....	86
Solution.....	392	Chills.....	98
Sterilization.....	169	Chloramine-T.....	412
Symbols.....	357	Chlorazene.....	412
Warfare.....	554	Chlorinated lime.....	412
Chlorine gas.....	555	Disinfectant.....	268
Cloud or drift gas.....	555	Chlorination of water.....	291, 313
Direct poisons of nervous system.....	557, 562	Chlorine:	
Explosion gases.....	557, 562	Gas.....	555
Gases, poisonous.....	557	Poisoning by.....	557
Lachrymatory gases (tear gases).....	557, 559	Chloroform.....	441
Lung irritants.....	557	Administration of.....	186
Medical aspects of.....	557	Liniment.....	398
Phosgene.....	557	Physiological action.....	186
Poison gas, used in World War.....	555	Use as anæsthetic.....	182, 185
Poison gas, use of.....	554	Chlorpicrine, poisoning by.....	557
Sternutatory gases (sneeze gases).....	557, 559	Choking, treatment for.....	90
Vesicant gases.....	557, 560	Cholagogues.....	408
Chemistry.....	353	Cholera.....	250
Acid-s.....	367, 402	Choroid.....	50
Phosphorous, graphic formula of.....	370	Chromatin.....	5
Sulphuric, graphic formula of.....	370	Chyme.....	36
Table of.....	381	Cilia.....	6
Acidimetry and alkalimetry.....	377	Ciliary process.....	50
Adhesion.....	356	Cinchona:	
Analysis.....	354	Compound tincture of.....	470
Atomic weight.....	356	Red.....	470
Atoms.....	355	Circulating fluids.....	19
Bases.....	371	Circulation:	
Blood.....	521	Drugs affecting.....	479
Brittleness.....	355	Of blood.....	25
Cohesion.....	355, 356	Pulmonary.....	25
Compounds.....	354	Systemic.....	25
Binary.....	361	Circulatory system, general.....	25
Naming of.....	360	Circumduction, joint.....	15
Ternary.....	361	Citric acid.....	449
Definition of.....	354	Civil employees, naval hospitals.....	582
Ductility.....	355	Commissary department:	
Elements.....	354	Ratings.....	650
Acid forming.....	369	Pay.....	650
Table of.....	379	Clarification.....	393
Energy.....	355	Clavicle.....	11
Force.....	355	Fracture of.....	81
Hardness.....	355	Cleanliness, wards.....	118
Hydroxyl.....	380	Clerical:	
Laws and theories.....	375	Force, organization of.....	622
Law of constant proportions.....	354	Work, medical department.....	614
Malleability.....	355		

	Page.		Page.
Clinical:		Commissary—Continued.	
Chart.....	123	Department—Continued.	
Notes.....	125	Food:	
Thermometer.....	120	Colors of.....	654
Clothing:		Inspection.....	667
Cotton.....	297	Kitchens.....	652
Fur.....	297	Masters-at-arms, mess hall.....	680
Infected.....	298	Meat cutter.....	680
Leather.....	297	Ménus.....	653
Linen.....	298	Table of foods found on.....	655
Paper.....	298	Mess attendant-s.....	680
Silk.....	297	Chief.....	680
Wool.....	297	Mess halls.....	652
Clotting of blood.....	22	Organization.....	651
Coagulation of blood.....	22	Pantrymen.....	680
Coca leaves, restriction in use.....	483	Personnel.....	678
Cocaine:		Duties of.....	678
Anæsthetic.....	190	Provisions:	
Hydrochloride.....	475	How procured.....	666
Overdosage.....	191	Issue of.....	673
Poisoning by.....	191, 493	Second cooks.....	679
Solutions.....	190	Storerooms.....	651
Sterilization of.....	190	Storeroom keepers.....	679
Use by drug addicts.....	484	Files.....	677
Cocci.....	503	Ledger.....	637, 675
Cochlea.....	51	Officer.....	650
Cockroaches, elimination of.....	274	Duties of.....	678
Cocoa.....	475	Steward, duties of.....	678
Butter.....	401, 460	Commissioned:	
Cod liver oil.....	460	Officers.....	592
Codeine.....	469	Warrant officers.....	592
Sulphate.....	470	Common iliac artery.....	28
Coeliac axis.....	27	Communicable disease-s.....	139
Cohesion, definition of.....	355, 356	Carrier.....	238
Colation.....	392	Cleaning.....	238
Cold-s.....	97	Contact.....	238
Applications.....	132	Means of transmission.....	238
Compresses.....	133	Modes of transmission.....	237
Cream, preparation of.....	402	On independent duty, examination for.....	531
Pack.....	158	Prevention and control of.....	237, 265
Colic:		Source of infection.....	237
Gall-stone.....	95	Communication office.....	584
Kidney-stone.....	95	Comparative anatomy, definition of.....	5
Collecting stations, regimental medical detachment.....	542	Complement-s:	
Colle's fracture.....	81	Blood.....	510
Collodions.....	396	Hospital Corps.....	609
Colloidal silver.....	438	Of naval hospitals.....	608
Colloids.....	395	Compound-s:	
Columnar cells.....	6	Binary.....	361
Colocynth, extract of.....	464	Chemical.....	354
Commensalism.....	511	Dislocation.....	75
Communion.....	391	Ternary.....	361
Commissary:		Compound tincture of cinchona.....	470
Department, naval hospitals—		Compression of the brain.....	92
Accounting and stock keeping.....	674	Concurrent disinfection.....	238
Bakers.....	680	Concussion of the brain.....	91
Base hospital.....	680	Condiments in foods.....	226
Bills, monthly payment of.....	676	Conduct of hospital corpsmen.....	563
Caloric values.....	654	Cone method administration of ether.....	185
Chief cook.....	679	Constipation, diet in.....	230
Civilian employees.....	650	Constitutional treatment, hæmorrhage.....	63
Clerk, duties of.....	679	Construction and Repair, Bureau of.....	587
Cuts of meats.....	662	Contingent, Bureau of Medicine and Surgery, appropriation.....	602
First cooks.....	679	Contracts, provisions, schedule of.....	666

	Page.		Page.
Contusion.....	71	Current—Continued.	
Convulsions.....	97	Interrupted galvanic.....	219
Cooking of meat.....	227	Primary.....	546
Coolidge tubes.....	545	Secondary.....	546
Copper:		Sinusoidal.....	219
Blue vitriol, cupric sulphate.....	439	Cutaneous membrane.....	19
Compounds of.....	439	Cuticle.....	40
Sulphate.....	439	Cuts of meats:	
Sterilization of water by.....	290	Beef.....	663
Cornea.....	50	Lamb.....	664
Cornstarch.....	461	Mutton.....	664
Corpuscles, white.....	20	Pork.....	665
Correctives.....	408	Veal.....	664
Correspondence, Medical Department.....	614	Cyanogen.....	380
Corrosive-s.....	477	Cytolysins.....	507
Mercuric chloride.....	435	Cytoplasm.....	5
Poisoning by.....	498	Daily routine duties, wards.....	117
Poisons.....	489, 490	Dakin's solution.....	169
Cortex of suprarenals, function of.....	38	Dalton's law.....	375
Cottonseed oil.....	459	Dark room, X-ray.....	550
Counterirritants.....	130	D'Arsonval current.....	221
Cowling's rule.....	410	Dead:	
Cranial nerves.....	47	Autopsy.....	570
Abducens.....	47	Care of the.....	568
Auditory.....	47	Deaths from unnatural causes.....	569
Facial.....	47	Dental record, value of.....	570
Glossopharyngeal.....	47	Finger prints of the.....	570
Hypoglossal.....	47	Identification of the.....	570
Oculomotor.....	47	Postmortem examinations of the.....	570
Olfactory.....	47	Preparation of body.....	569, 573
Optic.....	47	Death-s:	
Pneumogastric.....	47	Examination for.....	567
Spinal accessory.....	47	Medicolegal matters.....	563
Trigeminal.....	47	Preparation of forms.....	644
Trochlear.....	47	Signs of.....	566
Cranium.....	9	Unnatural causes, conduct in.....	569
Cresol.....	447	Decantation.....	392
Creosote.....	448	Decoction.....	395
Carbonate.....	448	Defecation.....	32
Crystallization:		Deficiency diseases. (<i>See Diseases.</i>).....	
Colloids.....	395	Deflagration.....	390
Crystalloids.....	395	Deglutition.....	32
Definition of.....	394	Delirants.....	408
Dialysis.....	394	Delousing.....	238
Interstitial water.....	394	Demulcents.....	408, 478
Osmosis.....	394	Dendrites.....	43
Water of.....	394	Dengue.....	254
Crystals.....	393, 394	Dental:	
Culex mosquito.....	519	First aid.....	110
Culicidæ.....	518	Hygiene.....	296
Culture media.....	502	Officers—	
Agar.....	502	Appointment of.....	607
Löffler's.....	502	Ranks and grades of.....	592
Procuring of.....	633	Record, value of in deaths.....	570
Simple nutrient broth.....	502	Dentine.....	110
Sterilization of.....	503	Dentistry:	
Cupping.....	132	Abscess, treatment for.....	112
Current:		Extraction of tooth.....	113
Constant galvanic.....	218	First aid.....	112
D'Arsonval.....	221	Gum boils.....	113
Faradic.....	219	Infection and inflammation.....	112
High frequency—		Temporary filling material.....	114
Method of application.....	221	Vincent's angina.....	114
Method of producing.....	220	Deodorants.....	408
Induced.....	546	Deodorizer.....	167

	Page.		Page.
Department of the Navy.....	583	Digestion—Continued.	
Assistant Secretary of the Navy.....	583	Process of.....	36
Bureaus of.....	583	Tanks, sewage disposal.....	293
Chief of Naval Operations.....	583	Digestive-s.....	478
Communication office.....	583	System.....	32
Office of—		Digitalis:	
Gunnery exercises and engineering		Poisoning by.....	493
performances.....	585	Tincture of.....	463
Naval Intelligence.....	585	Dimorphous.....	374
Secretary of the Navy.....	583	Diphenyl-chlorarsine gas.....	557, 559
Departmental contracts.....	633	Diphenyl-cyanarsine gas.....	557
Depressants.....	481	Diphtheria.....	144, 241
Poisoning by.....	490	Disaccharides.....	224
Derma.....	40	Discharge, preparation of forms.....	645
Dermacentor andersoni.....	518	Disease-s:	
Dermatol.....	433	Bacillary dysentery.....	142
Deserter, return of, preparation of forms.....	645	Beriberi.....	285
Desertion, preparation of forms.....	644	Bronchitis, acute.....	143
Dessication.....	391	Care in handling.....	139
Destroyer squadron medical officer, duties of.....	530	Caisson.....	277
Diabetes, diet in.....	230	Chicken pox.....	141
Diacetylmorphine hydrochloride (Heroin)...	470	Cholera.....	142
Dialysis.....	394	Common eruptive.....	137
Diaphoretics.....	408, 482	Communicable.....	137, 139
Diarrhœa.....	97	On independent duty.....	527, 531
Diet in.....	230	Diphtheria.....	144
Diathermy, technique of giving.....	221	Endocarditis, acute.....	145
Dichloramine-T.....	412	Eruptive.....	139
Dierotic pulse.....	123	Erysipelas.....	143
Diet-s:		Food deficiency.....	285
Anæmia.....	230	Influenza.....	144
Antiscorbutic.....	226	Malaria.....	142
Cardiac diseases.....	230	Measles.....	139
Classification of.....	231	Meningitis.....	145
Constipation.....	230	Miscellaneous.....	261
Diabetes.....	230	Mumps.....	141
Diarrhœa.....	230	Nephritis, acute.....	146
Fever.....	231	Of lower animals which may be trans-	
Food, serving of.....	229	mitted to man.....	260
Gastric ulcer.....	230	Pellagra.....	285
Gout.....	230	Physical signs of.....	138
In diseases.....	229	Pneumonia.....	144
Karell.....	231	Respiratory tract.....	143
Lenhartz.....	230	Rheumatic fever.....	146
Liquid.....	231	Rickets.....	285
Nephritis.....	230	Scarlet fever.....	140
Obesity.....	231	Scurvy.....	285
Planning of.....	226	Septicæmia.....	143
Postoperative cases.....	149	Small pox.....	140
Regular.....	232	Suppurative tonsillitis.....	145
Sippy.....	230	Symptoms of.....	138
Soft.....	231	Objective.....	138
Tuberculosis.....	231	Subjective.....	138
Dietetics. (See Food and Dietetics.)		Tetanus.....	143
Differential blood count.....	505	Tonsillitis, follicular.....	145
Digestants.....	408	Transmitted by—	
Digestion:		Direct contact.....	257
Absorption.....	32	Discharges from intestinal tract.....	250
Definition of.....	32	Discharges from mouth and nose.....	240
Deglutition.....	32	Insects and other arthropods.....	142, 254
Disturbance of.....	286	Tuberculosis.....	144
Enzymes.....	32	Typhoid fever.....	141
Insalivation.....	32	Typhus.....	143
Mastication.....	32	Venereal.....	324
Peristalsis.....	32	Examination of crew.....	531
Pharmaceutical.....	395	Vincent's angina.....	145

Disease-s—Continued.	Page.	Dressing-s—Continued.	Page.
Water borne.....	137, 141	Surgical. (<i>See</i> surgical dressings.)	
Xerophthalmia.....	285	Wet.....	66
Yellow fever.....	142	Antiseptic.....	66, 68
Disinfectant-s.....	408, 477, 479	Dried suprarenals.....	466
Bichloride of mercury.....	267	Drug-s:	
Boiling.....	265	Action, influenced by conditions.....	410
Burning.....	265	Addiction.....	483
Carbolic acid.....	267	Definition of.....	483
Chemical solutions.....	267	Addicts—	
Chlorinated lime.....	268	Classes of.....	485
Formaldehyde.....	269	Number of.....	484
Formalin.....	268	Administration of.....	410
Gaseous.....	268	Affecting:	
Hydrocyanic-acid gas.....	270	Blood.....	410
Lime.....	268	Circulation.....	479
Phenol.....	267	Heart.....	479
Physical.....	265	Vessels.....	479
Potassium mercuric iodide.....	267	Alkaloidal.....	467
Pulmonary.....	480	Anæsthetics.....	407, 481, 484
Steam.....	266	Analgesics.....	407, 477
Sulphur dioxide.....	268	Anodynes.....	407, 477
Sunlight.....	265	Antacids.....	407, 478
Surgical use of.....	167	Anthelmintics.....	407, 479
Disinfection:		Antiemetics.....	407
Concurrent.....	238	Antipyretics.....	407
Terminal.....	239	Antiseptics.....	167, 408, 477, 478, 482
Dislocation.....	73	Antispasmodics.....	408
Complicated.....	76	Astringents.....	408, 477, 482
Compound.....	75	Bitters.....	408, 478
Elbow.....	75	Carminatives.....	408, 478
Finger joints.....	74	Caustics.....	408, 477
Hip.....	75	Cocaine, use by addicts.....	484
Jaw.....	74	Corrosives.....	477
Knee.....	75	Demulcents.....	408, 478
Shoulder.....	74	Depressants.....	481
Treatment for.....	73	Diaphoretics.....	408, 482
Dispensary-ies:		Digestants.....	408
Marine Corps posts.....	540	Digestives.....	478
Naval.....	607	Disinfectants.....	408, 477, 479
Dispensatory, description of.....	384	Diuretics.....	408, 480
Dispensing.....	565	Emetics.....	408, 478
Distillation.....	390	Emollients.....	477
Destructive.....	391	Escharotics.....	408
Fractional.....	390	Expectorants.....	408
Distilled water.....	287, 414	Flavoring substances.....	478
Diuretics.....	408, 480	Habit, manner of acquiring.....	485
Dosage.....	410	Hæmostatics.....	408
Douche-s:		Hypnotics.....	409, 481
And irrigations.....	161	Irritants.....	409, 482
Ear.....	162	Mydriatics.....	409, 482
Eye.....	162	Myotics.....	409, 482
Hydrotherapy.....	211, 212	Narcotics.....	409, 481
Circular.....	211	On supply table, classification of.....	477
Fan.....	211	Opium, use by addicts.....	484
Jet.....	211	Protectives.....	477
Scottish or alternate.....	212	Pulmonary:	
Shower.....	211	Disinfectants.....	480
Pharyngeal.....	161	Sedatives.....	409
Drains, surgical.....	171	Purgatives.....	409, 479
Dressing-s.....	66	Soporifics.....	409, 484
Antiseptic.....	66	Specifics.....	409
Aseptic.....	66	Starchy and mucilaginous.....	461
Dry, sterile.....	66	Stimulants.....	407, 481
First-aid packet.....	66	Styptics.....	409, 477
Kinds of.....	156	Sudorifics.....	482
Station, shore patrol.....	537	Used by addicts.....	483

Drug-s—Continued.	Page.	Eggs—Continued.	Page.
Vegetable, containing cathartic principles.....	464	Scrambled.....	234
Drying of food.....	673	Soft cooked.....	233
Ductility, definition of.....	355	Elaterin.....	465
Ductless glands.....	38	Elbow, dislocation of.....	75
Ductus deferens (vas deferens).....	42	Electric:	
Duodenal:		Pads.....	133
Alimentation.....	229	Shock.....	91
Ulcer.....	95	Electrical properties of elements.....	361
Duty-ies:		Electricity, characteristics of.....	361
Ambulance party—		Electrocoagulation.....	221
Equipment of.....	533	Electrode treatments:	
Pack carrier.....	534	Nonvacuum.....	221
Battalion of ship.....	535	Vacuum.....	221
Bureau of Medicine and Surgery....	538, 589, 600	Electrolysis.....	361
Concerning infectious and contagious diseases.....	527	Electrolytes.....	361
Expeditionary force.....	539	Electrolytic dissociation.....	361, 362
Health records, care of.....	527	Electrotherapy.....	218
Hospital corpsmen:		Autocondensation.....	221
Administrative and clerical.....	582	Diathermy, technique of giving.....	221
Independent of medical officers.....	525	Electrocoagulation.....	221
Landing force.....	534	Electrode treatments.....	221
Medical journal, independent duty..	528	Elements.....	354
Medicolegal matters.....	563	Acid forming.....	369
Patients, care of.....	529	Allotropic modifications.....	374
Transfer of.....	528	Amorphous forms of.....	374
Personnel, naval hospital.....	581	Chemical formulas of.....	357
Property accountability.....	528	Chemical symbols of.....	363
Property, transfer of.....	528	Classification of.....	373
Recruiting.....	575	Crystalline form of.....	373
Reports, preparation of.....	529	Dimorphous forms of.....	374
Sanitary investigations.....	526	Direct combination.....	364
Shore patrol.....	533, 535	Displacement.....	364
Sick call.....	527	Double decomposition.....	364
Stores, care of.....	528	Electrical properties of.....	361
With ship's landing force.....	533	Electrolysis.....	361
Dying declarations.....	566	Electrolytic dissociation.....	361, 362
Dysentery:		Equations.....	363
Amœbic.....	251	Formulas, chemical, writing of.....	369
Bacillary.....	251	General consideration of.....	372
Dyspnœa.....	32	Halogen.....	411
Ear:		Ion.....	362
Ache.....	98	Ionization.....	361
Cochlea.....	51	Isomorphous forms of.....	374
Description of.....	51	Metals.....	373, 374
Douché.....	162	Nonmetals.....	373
Endolymph.....	51	Osmotic pressure.....	362
Middle.....	51	Oxidation.....	375
Removal of foreign bodies from.....	87	Oxidizing agents.....	375
Earth-s:		Polymorphous forms of.....	374
Alkaline.....	374	Radicle-s.....	367, 368
Elements:		Reactions.....	363
Barium.....	427	Reversible.....	366
Calcium.....	427	Reducing agents.....	375
Magnesium.....	427	Reduction.....	375
Strontium.....	427	Simple decomposition.....	364
Ectoparasites.....	511	Substitution.....	364
Effects, patients'.....	564	Table of.....	379
Effluage.....	193	Elixirs.....	396
Eggs:		Elutriation.....	391
As food.....	227	Embalming.....	347
Coddled.....	233	Embryology, definition of.....	5
Poached.....	233	Emetics.....	408, 478
		Emetine hydrochloride.....	475
		Emollients.....	477

	Page.		Page.
Emulsions.....	396	Executive officer, Naval Hospitals.....	580
Enamel.....	110	Exercise, effect on health.....	296
Endocarditis, acute.....	145	Excretions.....	39
Endocardium.....	23	Expectorants.....	408
Endolymph.....	51	Expenditure, force duties.....	529
Endoparasites.....	511	Expense analysis register.....	636
Enemata.....	150	Expense analysis statement.....	636
Classes of.....	150	Expeditionary forces:	
Nutrient, method of administering.....	228	Duties with.....	539
Energy:		First-aid man.....	541
Definition of.....	355	Force surgeon.....	540
Value of food.....	224	Medical department organization.....	540
Engineering, Bureau of.....	588	Regimental—	
Enlisted personnel, ratings.....	593	Medical detachment.....	541
Enlistment, preparation of forms.....	647	Surgeon.....	540
Entamoeba histolytica.....	511	Explosion gases:	
Enterocolysis.....	148, 151	Carbon monoxide.....	557, 562
Enzymes.....	32	Oxides of nitrogen.....	557, 563
Action of.....	37	Expression.....	395
Eosin stain.....	503	Exsiccation.....	391
Eosinophiles.....	21	Extensibility, muscle.....	16
Epidermis.....	40	Extension, joint.....	15
Epididymitis.....	331	Extracts.....	400
Treatment of.....	331	Belladonna leaves.....	472
Epilepsy or fits.....	91	Cascara sagrada.....	465
Epistaxis (nose bleed).....	61	Colocynth.....	464
Epithelial cells.....	6	Leptandra.....	464
Equations, chemical.....	363	Extraction, drugs:	
Equipment:		Decoction.....	395
Ledger.....	637	Digestion.....	395
Postmortem examinations.....	571	Expression.....	395
Shore patrol.....	536	Infusion.....	395
Specimens, postmortem examinations.....	573	Maceration.....	395
Erepsin.....	37	Menstruum.....	395
Ergot, fluidextract of.....	476	Percolation.....	395
Eruptive diseases.....	139	Eye:	
Erysipelas.....	143	Aqueous humor.....	50
Erythema dose, X-ray.....	552	Choroid.....	50
Erythroblasts.....	7	Ciliary process.....	50
Escharotics.....	408	Cornea.....	50
Essential oils.....	403	Description of.....	50
Esters of organic acids.....	449	Douche.....	162
Etamœba coli.....	511	Hyaloid membrane.....	50
Ether:		Iris.....	50
Administration of.....	185	Lens, crystalline.....	50
Bed.....	135	Lids.....	49
Sulphuric.....	445	Muscles of.....	50
Use as anæsthetic.....	182	Pupil.....	50
Ethers:		Removal of foreign bodies from.....	87
Definition of.....	445	Retina.....	50
Ethmoid bone.....	9	Sclera.....	50
Ethyl chloride.....	442	Strain.....	283
Use as anæsthetic.....	182, 187	Vitreous body.....	50
Eucaine, use as anæsthetic.....	190	Wounds of.....	71
Eucalyptol.....	454	Facial nerves.....	47
Examinations, dark field.....	506	Fahrenheit scale.....	390
For treponema pallidum.....	506	Faradic current.....	219
Eugenol.....	453	Fasciolopsis buski.....	373
Excitants, poisoning by.....	490	Fats.....	459
Excretory organs:		Source of.....	224
Alimentary tract.....	39	Unsaponifiable.....	403
Functions of.....	39	Febri-fuges.....	408
Lungs.....	39	Feeding:	
Skin.....	39	Special methods of.....	228
Urinary system.....	39	Feet, care of.....	323
		Fehling's test.....	523

	Page.	First-aid treatment of—Continued.	Page.
Femur:		Hiccough.....	97
Description of.....	13	Hysterical unconsciousness.....	92
Fracture of.....	82	Inflammation.....	57
Ferric:		Intestinal obstruction, acute.....	94
Chloride, tincture of.....	431	Kidney-stone colic.....	95
Citrochloride, tincture of.....	31	Poisoning, acute abdominal symptoms.....	96
Pyrophosphate, soluble.....	431	Poisonous insect bites.....	70
Fever-s:		Removal of foreign bodies.....	86
Care of patient.....	96	Shock.....	60
Definition of.....	52	Electric.....	91
Diet in.....	231	Snake bites.....	70
Fiber, nerve.....	43	Sore throat.....	98
Fibrinogen.....	21	Sprain.....	72
Fibula, description of.....	14	Strain.....	72
Field medical supply depot, regimental medical detachment.....	544	Suffocation.....	89
Field sanitation.....	311	Unconsciousness.....	90
Filament circuit, X-ray.....	548	Unconsciousness caused by alcoholism.....	93
Filaria:		Uræmia.....	93
Bancrofti.....	516	Wounds.....	65
Mosquito.....	519	First aid and minor surgery.....	57
Files:		Fish as food.....	227
Commissary.....	677	Fixation of complement.....	510
Provision requisition.....	677	Fixed oils and fats.....	403, 459
Ration memoranda.....	678	Flavoring substances.....	478
Stock card.....	678	Flavors in foods.....	226
Filing system, Medical Department.....	623	Fleas.....	520
Filters, water.....	290	Destruction of.....	273
Filtration.....	393	Fleet, organization of.....	595
Water.....	290	Flexion, joint.....	15
Finger-s:		Flies.....	520
Bones of.....	12	Fluidextract-s.....	397
Fracture of.....	82	Buchu.....	456
Joints, dislocation of.....	74	Cascara sagrada, aromatic.....	465
Prints, of dead.....	570	Ergot.....	476
First aid:		Ipecac.....	475
Definition of.....	57	Ginger.....	454
Dressing.....	66	Hyoscyamus.....	473
In dentistry.....	112	Rhubarb.....	465
Man, expeditionary force.....	541	Wild cherry.....	456
Packet.....	66	Fluorine.....	411
First-aid treatment of:		Fluoroscopy.....	549
Abdomen, acute conditions of.....	93	Follicular tonsillitis.....	145
Abscess.....	58	Fomentations.....	210
Apoplexy.....	92	Food-s:	
Appendicitis, acute.....	94	Adulteration.....	671
Asphyxia.....	89	Amount.....	284
Boil or furuncle.....	58	And dietetics.....	222
Bright's disease.....	93	Animal.....	227
Bruise.....	72	Bacon.....	227
Carbuncle.....	58	Beef.....	227
Chills.....	98	Beverages.....	226
Cold.....	97	Calcium in.....	226
Compression of brain.....	92	Canning.....	673
Concussion of brain.....	92	Carbohydrates.....	223
Contusion.....	72	Cereals.....	228
Convulsions.....	97	Chemical preservatives.....	673
Diarrhoea.....	97	Classification of.....	223
Dislocation.....	73	Cold, preservation by.....	672
Earache.....	98	Colors of.....	654
Epilepsy or fits.....	91	Composition.....	285
Fractures.....	77	Condiments.....	226
Gallstone colic.....	95	Definition of.....	222
Gastric or duodenal ulcer, perforated.....	95	Drying.....	673
Hæmorrhage.....	61	Eggs.....	227
Headache.....	97	Energy value of.....	224
Heat exhaustion.....	84	Fats.....	224
Heat stroke.....	84	Fish.....	227
		Flavors.....	226

Food-s—Continued.	Page.	Form-s—Continued.	Page.
Fruits.....	228	B.....	630
Green vegetables.....	228	Ba.....	630
Ham.....	227	B-dental.....	630
Inorganic.....	223	Civilian employees.....	648
Inspection.....	667	Death—	
Eggs.....	669	Marine.....	643
Fish.....	670	Navy.....	643
Meats.....	667	Nurse Corps.....	643
Milk and cream.....	670	Officer, Navy or Marine Corps.....	642
Poultry, thawed out.....	669	Supernumerary.....	644
Shellfish.....	671	Departure—	
Its relation to health and disease.....	283	Duty—	
Lamb.....	227	Navy.....	641
Legumes.....	228	Nurse Corps.....	641
Meat.....	227	Officer.....	640
Milk.....	227	Patient—	
Mutton.....	227	Marine.....	642
Nuts.....	228	Marine officer.....	641
Organic.....	223	Navy.....	641
Parasites, animal and plant in.....	284	Navy officer.....	641
Phosphorus in.....	226	Nurse Corps.....	642
Poisons.....	490	Supernumerary.....	642
Accidentally or purposely added		Deserter, reporting on board.....	645
to.....	284	Desertion.....	644
Natural.....	284	Discharge—	
Special.....	284	Expiration of enlistment—	
Pork.....	227	Marine.....	645
Poultry.....	227	Navy.....	645
Preservation.....	672	Patient—	
Preserving.....	673	Marine, I. S.....	646
Proteins.....	223	Navy, I. S.....	646
Metabolism of.....	223	Officer, I. S.....	646
Requirements of individuals.....	225	Retirement, Navy.....	645
Roots and tubers.....	228	Sentence, summary court-martial....	645
Salting and pickling of.....	673	Marine patient.....	646
Salts.....	223	Enlistment, extension of, or reenlistment.	647
Serving of.....	229	F.....	529
Smoking.....	673	Hospital Corps.....	637
Toxins.....	284	K.....	529
Veal.....	227	Leave—	
Vegetable.....	228	Absence without—	
Viscera, animal.....	227	Navy.....	647
Vitamines.....	226, 285	Patient, marine.....	647
Foot:		Supernumerary.....	647
Bath.....	159	Marine, patient.....	647
Fracture of.....	83	Navy.....	647
Foramen magnum.....	9	Nurse Corps.....	647
Foramina.....	7, 9	Officer.....	647
Force, definition of.....	355	Preparation of.....	638
Force surgeon, expeditionary.....	540	Prescribed for letters.....	616
Forearm, fracture of bones of.....	81	Rating—	
Foreign bodies, removal of.....	86	Advancement in.....	648
Foreword.....	V	Reduction in.....	648
Form-s:		Remains, shipment of.....	648
Arrival—		Requisitions, headstones.....	648
Duty—		Returns.....	649
Navy.....	638	Telegrams.....	649
Nurse Corps.....	640	Transfer—	
Officer.....	639	Marine enlisted, hospital insane.....	648
Patient—		Navy enlisted, hospital insane.....	648
Marine.....	639	Officer, marine, hospital insane.....	648
Marine officer.....	639	Officer, Navy, hospital insane.....	648
Navy.....	638	Patient to Fitzsimmons General Hos-	
Navy officer.....	639	pital.....	648
Nurse Corps.....	640	Supernumerary, hospital insane.....	648
Supernumerary.....	640	1.....	630

Form-s—Continued.	Page.	Gas-es:	Page.
4.....	630	Cloud or drift.....	555
N. M. S. H. 36, ration return.....	676	Funnel.....	273
N. M. S. H. 37, receipt and expenditure voucher.....	674	Poison.....	554
S. and A. 44.....	631	Gaseous poisons.....	490
Formaldehyde.....	169	Gasoline and benzine poisoning.....	496
Disinfectant.....	269	Gastric:	
Solution of.....	444	Juice—	
Sterilization by.....	169	Description of.....	36
Formalin, disinfectant.....	268	Hydrochloric acid.....	36
Formula-æ:		Lipase.....	36
Chemical.....	357	Pepsin.....	36
Empirical.....	358	Peptones.....	36
Graphic.....	358	Protooses.....	36
Rational.....	358	Rennin.....	36
Stereochemic.....	358	Tonics.....	409
Structural.....	358	Ulcer, diet in.....	230
For radicle.....	368	Gastro-pulmonary membrane.....	19
Writing of.....	369	Gauze dressings.....	170
Formulary. (See National.)		Gavage.....	155
Foreign bodies, removal of.....	86	Gay Lussac's law.....	376
Fowler's position.....	189	General ledger.....	637
Fracture-s:		Genital organs, male.....	42
Bed.....	135	Genito-urinary membrane.....	19
Bones of forearm.....	81	Gentian:	
Clavicle.....	81	Compound tincture of.....	464
Colle's.....	81	Violet stain.....	503
Comminuted.....	76	German measles.....	242
Complete.....	76	Ginger, fluidextract of.....	454
Complicated.....	76	Glacial acetic acid.....	449
Compound.....	76	Gland-s.....	18
Diagnosis of.....	77	Compound.....	19
Femur.....	82	Ductless.....	19, 38
Fingers.....	82	Lachrymal.....	49
Foot.....	83	Pancreas.....	34
Humerus.....	81	Parathyroid.....	38
Impacted.....	76	Functions of.....	38
Incomplete or green stick.....	76	Pineal body.....	39
Leg.....	83	Pituitary body.....	39
Lower jaw, symptoms and treatment.....	80	Simple.....	19
Metacarpals.....	82	Suprarenal.....	38
Multiple.....	76	Function of.....	38
Nose, symptoms and treatment.....	80	Sweat.....	40
Patella.....	82	Testicles.....	42
Pelvis.....	82	Thymus.....	38
Pott's.....	83	Thyroid.....	38
Rib, symptoms and treatment.....	80	Function of.....	38
Setting of.....	78	Types of.....	19
Skull.....	79	Gleet.....	327
Spine.....	79	Glossina palpalis.....	520
Splints.....	78	Glossopharyngeal nerves.....	47
Treatment for—		Glucose.....	399
Compound.....	78	Glucosides.....	403, 462
Simple.....	77	Glycerin.....	399, 402
Friction.....	194	Suppositories.....	40
Frontal bone.....	9	Glycerite-s.....	397
Fruits as food.....	228	Of starch.....	402
Fumigation.....	239, 411	Glycogen.....	35
Preparation of spaces.....	272	Source of.....	35, 37
Ships.....	271, 272	Glycyrrhiza:	
Fusion.....	390	Compound mixture of.....	462
Galenic preparations.....	395	Compound powder of.....	462
Gall bladder, description of.....	35	Pure extract of.....	462
Gall-stone colic.....	95	Gonorrhoea.....	258, 326
Ganglia.....	43	Chronic.....	327
Ganglionic nervous system.....	43	Diagnosis of.....	326
Garbage, disposal of.....	295	Epididymitis.....	328
		Gleet.....	327

Glycyrrhiza—Continued.	Page.	Heart—Continued.	Page.
Incubation period.....	326	Stenosis.....	24
Infection by, effects of.....	325, 326	Valves.....	24
Prostatitis.....	328	Heat:	
Stricture of urethra.....	329	Calcination.....	390
Symptoms of.....	327	Carbonization.....	390
Treatment of.....	329	Definition of.....	389
Gonorrhoeal ophthalmia and treatment.....	332	Deflagration.....	390
Gout:		Desiccation.....	391
Diet in.....	230	Distillation.....	390
Grain weight.....	385	Exhaustion.....	84
Gram's method of staining.....	504	Exsiccation.....	391
Granulation.....	391	Fusion.....	390
Green vegetables as food.....	228	Granulation.....	391
Guard duty, medical.....	532	Ignition.....	390
Guaiacol.....	448	Incineration.....	390
Gum arabic.....	461	Method of measuring.....	389
Gumboils.....	113	Regulation of body.....	52
Gunshot wounds.....	71	Stroke.....	83
Gymnastics, medical.....	197	Sublimation.....	390
Hæmatology.....	501	Torrefaction.....	390
Hæmatoxylin and eosin stain.....	503	Vaporization.....	390
Hæmoglobin.....	20, 506	Heating:	
Hæmolysis.....	22	Direct.....	280
Hæmoptysis.....	64	Direct-indirect.....	280
Hæmorrhage.....	60	Indirect.....	280
Arterial.....	61	Methods used in.....	280
Capillary.....	61	Henry's law.....	377
Consecutive or intermediate.....	64	Hepatic:	
Constitutional treatment for.....	63	Duct.....	35
Epistaxis (nose bleed).....	61	Stimulants.....	409
From lips.....	63	Hernia.....	18
From scalp.....	63	Heroin.....	470
Internal.....	64	Poisoning by.....	493
Lung.....	64	Use by drug addicts.....	487
Pressure.....	62	Herpes.....	346
Primary.....	64	Hexamethylenamine.....	445
Secondary.....	64	Hiccough.....	97
Stomach.....	64	High frequency current.....	220
Tourniquet, use of, in.....	62	Method of—	
Treatment for.....	61	Application.....	221
Venous.....	61	Producing.....	220
Hæmostatics.....	408	Hip:	
Halogen:		Bone.....	13
Derivatives—		Dislocation of.....	75
Chloroform.....	441	Histology, definition of.....	5
Ethyl chloride.....	442	History of Hospital Corps.....	1
Iodoform.....	441	Homatropine hydrobromide.....	473
Elements.....	411	Honeys.....	398
Ham as food.....	227	Hookworm-s.....	515
Hand.....	12	Disease.....	252
Hardness, definition of.....	355	Hormones.....	521
Harrison narcotic law.....	405, 482	Hospital company, regimental medical de- tachment.....	543
Headache.....	97	Hospital Corps, complements.....	609
Headstones, requisitions for.....	648	Hospital corpsmen:	
Health records, care of.....	527	Conduct of.....	563
Heart:		Duties of.....	525, 582
Action of.....	24	Death, examination for.....	567
Blood supply of.....	24	Dispensing.....	565
Description of.....	23	Dying declarations.....	566
Drugs affecting.....	479	Insane, care of.....	565
Endocardium.....	23	Poisons, handling of.....	565
Murmurs.....	24	Professional ethics.....	116
Myocardium.....	23	Qualifications necessary for.....	115, 116
Nerve supply.....	24	Hospital ticket.....	564
Pericardium.....	23		

	Page.		Page.
Hospitals, naval.....	601	Hydrous wool fat.....	460
Accounting—		Hydroxyl.....	380
And property officer.....	634	Hygiene:	
System.....	636	And sanitation.....	237
Administration of.....	608	Personal—	
Civil employees at.....	582	Bowels, care of.....	296
Commanding officer.....	580	Clothing.....	297
Commissary department at.....	650	Definition of.....	296
Complements.....	608	Dental.....	296
Designation as.....	579	Exercise, effect on health.....	296
Executive officer.....	580	Mental state, effect on health.....	296
Field.....	579	Hymenolepsis nana.....	514
General plans, arrangement and manage-		Hyoscyamus.....	473
ment of.....	579	Fluid extract of.....	473
Hospital corpsmen.....	581	Poisoning by.....	494
Medical officers.....	581	Hypermetropia.....	51
Navy base.....	579	Hypnotics.....	409, 481
Nurses.....	582	Hypodermic:	
Personnel, duties of.....	581	Injection, method of giving.....	128
Hospitals, Navy Base:		Outfit.....	128
Organization of.....	612	Solution, filtering of.....	392
Personnel of.....	611	Hypodermoclysis.....	148, 411
Hosts, animal parasites.....	511	Hypoglossal nerves.....	47
Hot:		Hypophysis, solution of.....	466
Applications.....	133	Hysterical unconciousness.....	92
Pack.....	159	Ice caps.....	133
Water bags.....	133	Ichthyol.....	440
Housing:		Identification:	
Congestion of population.....	282	Of dead.....	570
Living conditions on board ship.....	282	Records.....	637
Of naval personnel.....	281	Tags.....	534, 637
Overcrowding.....	281	Idiosyncrasy.....	410, 509
Standards for barracks.....	282	Food.....	286
Humerus.....	11	Ignition.....	390
Fracture of.....	81	Illumination. (<i>See</i> Light).	
Hyaloid membrane.....	50	Imhoff tanks, sewage disposal.....	294
Hydrated chloral.....	444	Immunity.....	507
Hydrocarbons.....	439	Acquired.....	507
Definition of.....	439	Active.....	507
Halogen derivatives of.....	441	Agglutinins.....	507
Ichthyol.....	440	Antibodies.....	507
Liquid petrolatum.....	440	Antitoxins.....	507
Paraffin.....	440	Bacteriolysins.....	507
Petrolatum.....	439	Cytolysins.....	507
Sulphonated oil.....	440	Inherent.....	507
Hydrochloric acid.....	415	Opsonins.....	507
Gastric juice.....	36	Passive.....	507
Poisoning by.....	494	Precipitins.....	507
Hydrocyanic acid:		Serums.....	508
Gas—		Schick test.....	507
Disinfectant.....	270	Toxins.....	507
Poison.....	557, 562	Incineration.....	390
Poisoning by.....	494	Incinerators, specifications of.....	316
Hydrogen.....	380	Incisura radialis.....	12
Acids.....	368	Semilunaris.....	12
Dioxide, solution.....	414	Incompatibility:	
Hydrogogues.....	408	Chemical.....	405
Hydrographic Office.....	586	Definition of.....	405
Hydrotherapy:		Pharmaceutical.....	405
Ablution.....	206	Therapeutic.....	405
Baths.....	206	Independent duty.....	525
Conditions of skin affecting.....	204	Indicator, chemical.....	377
Effect of cold.....	205	Infected clothing.....	298
Reaction in.....	205	Infection of wounds.....	166, 167
Technique of.....	205	Inferior:	
Wet pack.....	208	Mesenteric artery.....	27
		Phrenic artery.....	27

	Page.		Page.
Inflammation.....	166	Iodine.....	413
Treatment of.....	57	Ointment.....	402
Influenza.....	144, 242	Poisoning by.....	494
Infusion.....	395, 397	Sterilization by.....	169
Saline.....	229	Tincture of.....	413
Infusoria.....	512	Iodoform.....	441
Inguinal ligament (Poupart's).....	18	Sterilization by.....	169
Inhalation, administration of drugs by.....	411	Ionization.....	361
Initial lesion, syphilis.....	334	Ipecac.....	474
Injuries:		Fluidextract of.....	475
Asphyxia.....	88	Iris.....	50
Burns and scalds.....	84	Iron:	
Cold or chilling.....	86	Chloride, tincture of.....	431
Contusions.....	71	Citrochloride, tincture of.....	431
Dislocations.....	73	Compounds of.....	431
Foreign bodies.....	86	Pyrophosphate, soluble.....	431
Fractures.....	76	Irrigation:	
Hæmorrhage.....	60	Bladder.....	153
Heat—		Nasal.....	161
Exhaustion.....	84	Saline.....	229
Stroke.....	83	Wounds.....	168
Inflammation.....	57	Irritability, muscle.....	16
Shock.....	59	Irritant-s.....	409, 482
Sprains.....	71	Gases, poisoning by.....	494
Strains.....	71	Poisoning by.....	498
Suffocation.....	88	Poisons.....	490
Sunstroke.....	83	Isolation.....	239
Unconsciousness.....	90	Isomorphous.....	374
Wounds.....	64	Jaborandi.....	474
Innominate vein.....	29	Jaw:	
Inorganic:		Dislocation of.....	74
Acids.....	415	Fracture, symptoms and treatment of... ..	80
Table of.....	381	Joint-s:	
Foods.....	223	Abduction.....	15
Materia medica.....	411	Adduction.....	15
Insalivation.....	32	Circumduction.....	15
Insane, care of.....	565	Extension.....	15
Insect-s:		Flexion.....	15
Bites.....	69	Immovable.....	14
Control of, in camp.....	318	Movable.....	14
Diseases transmitted by.....	142	Movements of.....	15
Flies.....	318	Rotation.....	15
Lice.....	321	Journal, accounting system.....	636
Mosquitoes.....	319	Judge Advocate General of the Navy.....	590
Inspection, food.....	667	Jugular veins.....	29
Instruments, surgical, care of.....	173	Karell diet.....	231
Intensifying screens, X-ray.....	551	Kidney-s.....	40
Internal hæmorrhage.....	64	Stone colic.....	95
Interstitial water.....	394	Kitchen, naval hospitals:	
Intestinal obstruction, acute.....	94	Diet.....	652
Intestine s:		Main.....	652
Description of.....	33	Knee, dislocation of.....	75
Large.....	34	Kocher's method for reduction of dislocation	
Small.....	33	of shoulder.....	75
Intramuscular:		Laboratory specimens, post-mortem examina-	
Administration of drugs.....	411	tions:	
Injection of mercury.....	342	Equipment for preserving.....	574
Intravascular:		Regulations for mailing.....	575
Administration of drugs.....	411	Lachrymal:	
Injection.....	229	Apparatus.....	49
Inunction-s.....	411	Bone.....	9
Nutrient.....	229	Canaliculi.....	49
Inventory.....	675	Glands.....	49
Invertin.....	37	Nasal duct.....	49
Iodide of iron, syrup of.....	398	Sac.....	49

Lachrymatory gases (tear gases), poison:	Page.	Light-ing—Continued.	Page.
Benzyl bromide.....	557	Operating room.....	163
Brom-benzyl cyanide.....	557, 559	Relation to health.....	282
Xylyl bromide.....	557, 559	Sick rooms.....	283
Lactase.....	37	Wards.....	283
Lamb:		Lime:	
As food.....	227	Chlorinated.....	412
Cuts of.....	664	Disinfectant.....	268
Landing force, duties with.....	534	Linen:	
Lanolin.....	460	Clothing.....	298
Lard.....	401, 460	Operating room:	
Larynx.....	30	Caps.....	170
Latin words used in pharmacy.....	404	Gowns.....	171
Latrines:		Masks.....	170
Care of.....	315	Removal of stains, from.....	118
Frontage.....	314	Liniment-s.....	397
Location.....	315	Amonia.....	398
Types of.....	315	Camphor.....	397
Lavage.....	154	Chloroform.....	398
Laws and theories:		Lime.....	398
Avogadro's.....	375	Soap.....	398, 461
Boyle's.....	376	Lipase.....	36
Charles'.....	376	Liquid:	
Chemical and physical equilibrium.....	377	Diet.....	231
Constant proportions.....	353	Measure.....	387
Dalton's.....	353, 375	Petrolatum.....	440
Gay Lussac's.....	376	Lithium citrate.....	426
Henry's.....	377	Liver:	
Molecular theory.....	375	Description of.....	35
Multiple proportions.....	375	Functions of.....	35
Newton's.....	355	Living spaces, lighting of.....	283
Laxatives.....	408	Löffler's medium.....	502
Lead:		Lotion.....	392
Acetate.....	334	Lozenges.....	401
Poisoning by.....	494	Lumbar:	
Leather clothing.....	297	Arteries.....	28
Leave, forms for.....	647	Lung-s.....	31, 39
Ledger:		Hæmorrhage from.....	64
Commissary.....	637, 675	Irritants, poison gases:	
Equipment.....	637	Chlorine.....	557
General.....	637	Chlorpicrine.....	557
Stock.....	636	General symptoms of.....	557
Leg, fracture of.....	83	Phosgene.....	557
Legumes, as food.....	228	Treatment of poisoning by.....	558
Lenhartz diet.....	230	Lymph:	
Lens, crystalline.....	50	Blood, definition of.....	22
Lepers, quarantine of.....	275	Vascular system:	
Leptospira icteroides.....	512	Description of.....	29
Leptandra, extract of.....	464	Thoracic duct.....	29
Letters, forms prescribed for.....	616	Lymphocytes.....	20
Leucocytes.....	20	Maceration.....	395
Levigation.....	391	Magnas.....	398
Lewisite gas.....	557	Magnesium.....	427
Lice.....	520	Carbonate.....	428
Destruction of.....	273	Sulphate.....	428
Licorice:		Mail-ing:	
Powder, compound.....	462	Cases, procuring of.....	633
Ligatures.....	172	Classes of.....	620
Light-ing:		Malaria.....	142, 255
And illumination.....	282	Benign tertian.....	513
Direct.....	283	Malignant tertian.....	513
Eyestrain caused by.....	283	Quartan.....	513
Indirect.....	283	Malleability, definition of.....	355
Lights, location of.....	283	Maltase.....	37
Living spaces.....	283	March, water supply on.....	290
Natural.....	282		

	Page.		Page.
Marching, field sanitation.....	321	Membranes.....	18
Marine Corps:		Cutaneous.....	19
Description of.....	597	Mucous.....	19
Titles.....	595	Serous.....	18
Maritime quarantine.....	274	Synovial.....	19
Marrow.....	6	Meningitis.....	147
Massage:		Menstruum.....	395
Abdominal.....	195	Menthol.....	453
Contraindications to.....	197	Ménus:	
General.....	194	Forms used for.....	653
General rules for.....	197	Regular diet.....	653
Manipulations of.....	193	Table of foods found on.....	655
Mass-es:		Mercurial ointment.....	402, 435
Definition of.....	355	Mercury:	
Pharmaceutical preparations.....	400	Ammoniated.....	437
Masters-at-arms, mess hall.....	680	Bichloride of.....	435
Mastication.....	32	Citrine ointment.....	436
Mastigophora.....	511	Compounds of.....	434
Materia medica:		Intramuscular injection of.....	342
Definition of.....	383, 407	Inunction of.....	342
Inorganic.....	411	Mass of.....	434
Organic.....	439	Ointment of.....	402, 435
Matter:		Mild chloride of.....	436
Characteristics of.....	354	Oleate of.....	435
Definition of.....	354	Salicylate of.....	437
Measles.....	139, 243	Succinamide of.....	437
Measure-s.....	386	Vapor arc lamp.....	217
Liquid.....	387	Yellow oxide of.....	435
Tables of.....	385	Yellow iodide of.....	437
t-s:		Mesenteric veins.....	29
As food.....	227	Mess attendants, naval hospitals.....	680
Inspection of.....	667	Mess-es (naval hospitals):	
Media, culture.....	502	Halls.....	652
Medical:		Nurses'.....	652
Department—		Sick officers'.....	652
Accounting.....	634	Staff officers'.....	652
Appropriations.....	602	Metabolism, disturbance of.....	286
Clerical force, organization of.....	622	Metacarpal bones.....	12
Clerical work.....	614	Metals:	
Duties with shore patrol.....	536	Base.....	374
Filing system.....	623	Elements.....	373
Personnel.....	607	Noble.....	374
Property accountability.....	634	Metatarsal bones.....	14
Public bills.....	631	Methyl:	
Supplies, procuring of.....	628	Alcohol.....	443
Journal, independent duty, care of.....	528	Salicylate.....	455
Officer-s—		Methylene blue stain.....	503
Appointment of.....	607	Metric system.....	385
Destroyer squadrons, duties of.....	530	Metrology, definition of.....	384
Naval hospitals.....	581	Micrometry.....	502
Ranks and grades of.....	592	Microorganisms in air.....	278
Squadron, duties of.....	530	Microscope, care of.....	501
Medicated baths.....	160	Micturition.....	42
Medicine-s:		Milk:	
Abbreviations on prescriptions.....	404	Pasteurization of.....	227
Administration of.....	125	Peptonized.....	232
By mouth.....	126	Sterilization of.....	227
Hypodermic method of giving.....	128	Middle:	
Hypodermic outfit.....	128	Ear.....	51
Oxygen inhalations.....	127	Sacral artery.....	28
Preventive. (<i>See</i> Preventive medicine.)		Mine depots.....	596
Steam inhalations.....	127	Mineral acids.....	415
Subcutaneous injections.....	127	Mineralogy, definition of.....	383
Medicine and Surgery, Bureau of.....	588, 598	Mites.....	517
Medicolegal matters.....	563	Mixtures, pharmaceutical.....	398
Medulla oblongata.....	46	Molecular theory.....	375

	Page.		Page.
Molecules.....	355	Naval:	
Monosaccharides.....	224	Base—	
Morgue, care of.....	571	Advance.....	597
Morphine:		Aviation.....	597
Poisoning by.....	494	Defined.....	597
Sulphate.....	469	Destroyer.....	597
Mosquito-es:		Main.....	597
Aedes.....	519	Main outlying.....	597
Anopheles.....	519	Outlying.....	597
Asiphonate.....	519	Submarine.....	597
Control in camp.....	319	Subsidiary.....	597
Culex.....	519	Depot, defined.....	597
Filaria.....	519	Hospitals. (<i>See</i> Hospitals.)	
Siphonate.....	519	Hospital fund.....	603, 674
Motor:		Intelligence, office of.....	585
Depressants.....	409	Observatory.....	586
Excitants.....	409	Operating bases.....	596
Mountain sickness.....	278	Policy, defined.....	597
Mouth, description of.....	32	Station-s.....	596
Mucilages.....	398	Defined.....	597
Mucous membrane.....	19	For upkeep of fleet.....	595
Mumps.....	141, 245	Torpedo.....	596
Murmurs, heart.....	24	Training.....	596
Musca domestica.....	520	Strategy, defined.....	597
Muscle-s:		Tactics, defined.....	597
Cardiac.....	16	Navigation, Bureau of:	
Contractility.....	16	Duties of.....	585
Definition of.....	15	Hydrographic Office.....	586
Division of.....	16	Naval Observatory.....	586
Extensibility.....	16	Navy:	
Inguinal ligament (Poupart's).....	18	Base hospitals.....	611
Irritability.....	16	Department.....	583
Non-striated (involuntary).....	16	Yards.....	596
Of—		Neacator americanus.....	515
Eye.....	50	Needles.....	68
Head and face.....	16	Nemathelminthes.....	514
Lower extremity.....	18	Neosarsphenamine.....	432
Neck.....	16	Treatment of syphilis.....	340
Trunk.....	16	Neosalvarsan.....	432
Upper extremity.....	18	Nephritis:	
Properties of.....	16	Acute.....	146
Rigor mortis.....	16	Diet in.....	230
Striated (voluntary).....	15	Nerve-s.....	43
Substance, changes in.....	16	Afferent.....	44, 48
Tissue.....	15	Center.....	44
Tonicity.....	16	Cerebral.....	47
Muscular system.....	15	Cranial.....	47
Mustard:		Description of.....	43
Gas.....	557, 560	Efferent.....	48
Plasters.....	131, 456	Fiber.....	43
Mutton:		Impulses.....	43
Cuts of.....	664	Mixed.....	44
As food.....	227	Motor.....	44
Mutualism.....	511	Reflex action.....	48
Mydriatics.....	409, 482	Sensory.....	44
Myology.....	15	Spinal.....	47
Myopia.....	51	Tissue.....	43
Myotics.....	409, 482	Vaso-motor.....	44
Narcotic-s.....	409, 481	Nervous system.....	43
Harrison Act or law.....	405, 482	Axones.....	43
Nasal:		Cerebrospinal.....	43
Chambers.....	30	Dendrites.....	43
Duct.....	49	Division of.....	43
National formulary, description of.....	384	Ganglionic.....	43
Natural preparations.....	402	Neurones.....	43
		Sympathetic.....	43, 48

	Page.		Page.
Neuroepithelial cells.....	6	Officer-s—Continued.	
Neurones.....	43	Commissioned—	
Neurotic-s.....	409	Of the line.....	592
Poisoning by.....	498	Of the staff.....	592
Poisons.....	489, 490	Warrant.....	592
Neutrophiles.....	21	Ranks and grades of—	
Newton's law.....	355	Abbreviations for.....	595
Nitre, sweet spirit of.....	452	Dental.....	592
Nitric acid.....	416	Medical.....	592
Poisoning by.....	495	Warrant.....	592
Nitrogen:		Oil-s:	
In air.....	276	Castor.....	459
Monoxide.....	414	Clove.....	453
Nitrous oxide, use as anæsthetic.....	182, 187	Cod liver.....	460
Noble metals.....	374	Cotton seed.....	459
Nonelectrolytes.....	362	Essential.....	403
Nonmetals, elements.....	373	Fixed.....	403, 459
Nonvacuum electrode treatment.....	221	Peppermint.....	452
Normal:		Santalwood.....	456
Salt-s.....	371	Sweet birch.....	455
Solution.....	168, 190, 424	Tar, rectified.....	454
Volumetric solutions.....	378	Theobroma.....	460
Nose:		Turpentine.....	457
Fracture of, symptoms and treatment... ..	80	Volatile.....	403
Removal of foreign bodies from.....	87	Wintergreen.....	455
Novocaine.....	476	Ointment-s.....	401
Use as anæsthetic.....	190, 191, 192	Belladonna.....	402
Nucleus.....	5	Iodine.....	402
Nurse-s:		Potassium iodide used in.....	402
Appointment of.....	607	Mercurial.....	402
Corps, titles.....	595	Oxide of mercury.....	402
Naval hospitals.....	582	Oleate-s.....	398
Navy base hospitals.....	611	Of mercury.....	402, 435
Operating room.....	176	Oleoresina aspidil.....	458
Surgical.....	176	Oleoresins.....	398, 457
Nursing.....	115	Olfactory nerves.....	47
Care, general.....	139	Operating:	
Of diseases—		Bases, naval.....	596
Communicable.....	139	Room—	
Restraining apparatus.....	137	Adjoining rooms.....	165
Surgical—		Anæsthetizing room.....	165
Bed sores.....	160	Asepsis.....	166
Douche-s.....	161	Care of patient on operating table.....	174
Ear.....	162	Cleanliness.....	164
Eye.....	162	Cleaning gear room.....	165
Pharyngeal.....	161	Conduct of personnel.....	178
Dressings.....	155	Equipment.....	164
Irrigation-s.....	161	Heating.....	164
Nasal.....	161	Hospital corpsmen.....	176
Preparation for operation.....	146	Instrument room.....	166
Wards, management and general supervision of.....	116	Lighting of.....	163
Nutrients.....	409	Nurse.....	176
Nutrient-s.....	409	Personnel of.....	175
Enemata.....	228	Preparation of—	
Inunctions.....	229	Hands.....	174
Nuts as food.....	228	Patient.....	174
Nux vomica.....	473	Size of.....	163
Poisoning by.....	495	Sterilizing room.....	165
Tincture of.....	473	Store room.....	166
Obesity, diet in.....	231	Surgeon.....	175
Oculomotor nerves.....	47	First assistant.....	175
Esophagus, description of.....	33	Second assistant.....	176
Officer-s.....	591	Surgical—	
Accounting and property.....	634	Dressings room.....	166
Chief warrant.....	592	Nurse.....	176
		Table.....	164

	Page.		Page.
Operating—Continued.		Oxygen.....	413
Ventilation.....	164	Acids.....	368
Wash room.....	165	Inhalations.....	127
Operating room and surgical technique.....	163	Oxyuris vermicularis.....	516
Operation:		Ozone, sterilization of water by.....	290
Hours for.....	163	Pack-s:	
Mouth, preparation for.....	147	Cold.....	158
Preparation for.....	176	Hot.....	159
Preparation of patient for.....	146, 180	Surgical dressings.....	170
Surgical—		Wet.....	208
Abdomen, preparation for.....	147	Packet, first-aid.....	66
Abdominal, infection present.....	149	Pancreas.....	34
Baths.....	149	Pancreatic juice:	
Bladder irrigation.....	153	Amylopsin.....	37
Catheterization.....	153	Description of.....	37
Diet—		Steapsin.....	37
Before operation.....	147	Trypsin.....	37
Post-operative.....	149	Paper clothing.....	298
Enemata.....	150	Paraffin.....	440
Enterocolysis.....	148	Paraglobulin.....	21
Technique of giving.....	151	Paragonimus westermanni.....	513
Gavage, nasal.....	155	Paraphimosis.....	331
Hypodermoclysis.....	148, 152	Parasites:	
Lavage.....	154	Animal.....	284
Nausea, control of.....	148	Arachnoids.....	517
Post-operative care.....	147, 148	Arthropoda.....	517
Proctoclysis.....	148, 151	Cestodes.....	513
Rectum, preparation for.....	147	Classification of.....	511
Suppository, rectal.....	151	Commensalism.....	511
Urine, examination of.....	148	Culicidæ.....	518
Opium:		Ectoparasites.....	511
And ipecac, powder of.....	469	Endoparasites.....	511
And lead, pill of.....	469	Female.....	511
Camphorated tincture of.....	469	Fleas.....	520
Poisoning by.....	495	Flies.....	520
Powdered.....	468	Hosts.....	511
Restriction in use.....	483	Infusoria.....	512
Tincture of.....	469	Insecta.....	518
Use by drug addicts.....	484	Lice.....	520
Oponins.....	507, 509	Male.....	511
Optic:		Mastigophora.....	511
Foramen.....	49	Mosquitoes.....	518
Nerves.....	47	Mutualism.....	511
Orange, compound spirit of.....	453	Nematelminthes.....	514
Orbit:		Of man.....	510
Optic foramen of.....	49	Pediculidæ.....	520
Sphenoidal fissure of.....	49	Platyhelminthes.....	513
Ordnance, Bureau of.....	587	Protozoa.....	511
Organic foods.....	223	Pulicidæ.....	520
Organization:		Rhizopoda.....	511
Clerical duties and procedures.....	582	Spirillæ.....	503
Medical department, expeditionary force.....	540	Sporozoa.....	512
Navy base hospitals.....	612	Ticks.....	518
Ornithodoros moubata.....	518	True parasitism.....	511
Osmosis.....	394	Worms.....	513
Osmotic pressure.....	362	Plant.....	284
Osteology, definition of.....	6	Parasiticides.....	409
Oxalic acid, poisoning by.....	495	Parathyroid glands, function of.....	38
Oxidation.....	375	Paratyphoid fever.....	253
Oxidizing agents.....	375	Patella:	
Oxide-s of:		Description of.....	14
Carbon.....	273	Fracture of.....	82
Mercury ointment.....	402	Pathogenic bacteria.....	503
Nitrogen, gases.....	557, 563	Pathology, definition of.....	5
Oxy-acids, table of.....	381		

Patient-s:	Page.	Pharmaceutical—Continued.	Page.
Admission to ward.....	116	Preparations—Continued.	
Care of.....	129	Mixtures.....	398
mouth.....	130	Mucilages.....	398
Confidence of.....	564	Natural.....	395, 402
Effects.....	564	Ointments.....	401
Inventory.....	564	Oleates.....	398
Hospital ticket.....	564	Oleoresins.....	398
Moving and lifting.....	136	Pills.....	400
Property, custody of.....	564	Plasters.....	400
Transfer of.....	528	Powders.....	400
Valuables.....	565	Resins.....	400
Fay, civilian employees, commissary depart-		Solid.....	395, 400
ment, naval hospitals.....	650	Solutions.....	398
Pediculæ.....	520	Spirits.....	398
Pediculus—		Suppositories.....	400, 401
Capitis.....	520	Syrups.....	398
Vestimenti.....	520	Tinctures.....	399
Pellagra.....	285	Vinegars.....	396
Pelvis.....	13	Waters.....	396
Fracture of.....	82	Pharmacists, appointment of.....	608
Penis.....	43	Pharmacognosy, definition of.....	383
Pepsin.....	36, 465	Pharmacopœia:	
Peptones.....	36	Description of.....	383
Percolation.....	393	Purity rubric.....	384
Percolate.....	394	Pharmacy:	
Percolator.....	394	Definition of.....	383
Pericardium.....	23	Practical.....	383
Peridental membrane.....	110	Theoretical.....	383
Periosteum.....	7	Pharyngeal douche.....	161
Peristalsis.....	32	Pharynx.....	33
Peritoneum.....	36	Phenacetin.....	449
Personnel:		Phenol-s.....	446
Commissary Department, naval hos-		Acetanilid.....	448
pitals.....	678	Acetphenetidin.....	449
Medical Department.....	607	And derivatives.....	445
Navy base hospitals.....	611	Antidote for.....	446
Of the Navy—		Antipyrine.....	448
Enlisted.....	593	Carbolic acid.....	446
Officer.....	591	Poisoning by.....	495
Perspiration.....	39	Cresol.....	447
Petrissage.....	194	Creosote.....	448
Petrolatum.....	439	Carbonate.....	448
Phagocytosis.....	20	Disinfectant.....	267
Phalanges.....	12	Guaicol.....	448
Pharmaceutical:		Liquefied.....	446
Arithmetic.....	388	Picric acid.....	447
Incompatibility.....	405	Resorcinol.....	447
Preparations.....	395	Tricresol.....	447
Cerates.....	400	Trinitrophenol.....	447
Chemical.....	395	Phenyl salicylate.....	450
Cold cream.....	402	Phenyleinchoninic acid.....	451
Collodions.....	396	Phimosis.....	331
Elixirs.....	396	Phosgene.....	555
Emulsions.....	396	Poison.....	557
Extracts.....	400	Phosphorus:	
Fluidextracts.....	397	Acid.....	371
Galenic.....	395	In foods.....	226
Glycerite-s.....	397	Physical change.....	353
Of starch.....	402	Phthirius pubis.....	520
Honey-s.....	398	Physics, definition of.....	383
Infusions.....	397	Physiological salt solution.....	168, 190
Liniments.....	397	Physiology, definition of.....	5
Liquid.....	395, 396	Physiotherapy:	
Lozenges.....	401	Definition of.....	193
Magmas.....	398	Effleurage.....	193
Masses.....	400	Friction.....	194

Physiotherapy—Continued.	Page.	Poisoning—Continued.	Page.
Gymnastics, medical.....	197	Corrosive.....	498
Massage:		Depressants.....	490
General.....	194	Digitalis.....	493
Manipulations of.....	193	Emetics.....	491
Petrissage.....	194	Excitants.....	490
Tapotement.....	194	Food.....	491, 493
Physostigmine sulphate.....	472	Gaseous.....	490
Pieric acid.....	447	Gasoline and benzine.....	496
Pill-s.....	400	Heroin.....	493
Of ferrous carbonate.....	432	Hydrochloric acid.....	494
Of lead acetate and opium.....	469	Hydrocyanic acid.....	494
Pilocarpine hydrochloride.....	474	Hyoscyamus.....	494
Pilocarpus.....	474	Iodine.....	494
Pineal body.....	39	Irritant.....	498
Pipettes.....	387	Gases.....	494
Pituitary body.....	39	Lead.....	494
Plague.....	256	Management of case, poison unknown.....	497
Plasma, blood.....	21	Morphine.....	494
Plasmodium:		Neurotic.....	498
Falciparum.....	513	Nitric acid.....	495
Malariae.....	513	Nux vomica.....	495
Vivax.....	513	Opium.....	495
Plaster-s.....	400	Oxalic acid.....	495
Of Paris bandage.....	108	Phenol (carbolic acid).....	495
Application of.....	109	Stomach tube, use in.....	499
Removal of.....	109	Strychnine.....	495
Platelets.....	21	Sulphuric acid.....	496
Platyhelminthes.....	513	Symptoms:	
Pleura.....	31	General.....	490
Plexuses.....	43	Table of.....	497
Pneumococcus.....	167	Treatment of.....	491, 497
Pneumogastric nerves.....	47	Trinitrotoluene.....	496
Pneumonia.....	144, 246	Viperine snake.....	70
Jacket.....	134	Poisonous:	
Poison-s:		Gases.....	90
Accidentally or purposely added to food.....	284	Wounds.....	69
Classification of.....	489	Policy, naval, defined.....	597
Corrosives.....	489, 490	Polymorphous.....	374
Definition of.....	489	Polymorphonuclear leucocytes.....	21
Effects of.....	489	Polysaccharides.....	224
Food.....	490	Polyvalence.....	359
Gas—		Pons Varolii.....	45
Use in World War.....	555	Pork:	
Use of.....	554	As food.....	227
Gaseous.....	590	Cuts of.....	665
Handling of.....	565	Posology, definition of.....	383
Irritants.....	489, 490	Portal system of circulation.....	29
Natural, food.....	284	Post-mortem examinations.....	570
Neurotics.....	489, 490	Equipment for.....	571
Special, food.....	284	Specimens.....	573
Poisoning:		Laboratory specimens.....	574
Aconite.....	491	Method of procedure.....	572
Acute.....	489	Post-operative care.....	147, 148, 188
Acute abdominal symptoms.....	96	Post surgeon-s:	
Alcohol:		Marine Corps posts.....	540
Ethyl.....	492	Office.....	539
Methyl.....	492	Potassium:	
Antidotes.....	491	Acetate.....	418
Arsenic.....	492	And sodium tartrate.....	419
Atropine.....	492	Arsenite, solution of.....	432
Belladonna.....	492	Bicarbonate.....	418
Bichloride of mercury.....	493	Bitartrate.....	419
Caustic alkalis.....	493	Bromide.....	419
Chronic.....	489	Chlorate.....	419
Cocaine.....	191, 493	Citrate.....	420
Colubrine snake.....	70	Hydroxide.....	418

	Page.		Page.
Potassium—Continued.		Proteoses.....	36
Iodide.....	420	Prothrombin.....	22
Used in iodine ointment.....	402	Protoplasm.....	5
Used in tincture of iodine.....	399	Protozoa.....	511
Mercuric iodide, disinfectant.....	267	Provision-s:	
Permanganate.....	420	Contracts, schedule of.....	666
Sterilization by.....	169	Dry.....	666
Pott's fracture.....	83	How procured.....	666
Poultices.....	131	Issue of.....	673
Poultry as food.....	227	Invoiced by supply officers.....	677
Powder-s.....	400	Nonstock items.....	666
Fineness of.....	391	Requisition file.....	677
Ipecac and opium.....	469	Stock items.....	666
Practical pharmacy.....	383	Public bills.....	631, 677
Precipitation.....	393	Special exigency.....	632
Precipitant.....	393	Pulicidæ.....	520
Precipitate.....	393	Pulmonary:	
Precipitins.....	507, 509	Artery.....	25
Prepared chalk.....	429	Disinfectants.....	480
Presbyopia.....	51	Sedatives.....	409, 480
Prescriptions:		Veins.....	28
Definition of.....	403	Pulp cavity.....	110
Filling of.....	404	Pulse.....	121
Model of.....	403	Description of.....	122, 123
Preservation, food.....	672	Pressure.....	26
Preservatives, chemical.....	673	Pupil of eye.....	50
Preserving food.....	673	Purgatives.....	409, 479
Prevention and control, communicable diseases, methods used in.....	265	Drastic.....	408
Preventive medicine.....	237	Saline.....	408
Definition of.....	237	Simple.....	408
Education in personal cleanliness.....	239	Purification, water.....	288, 313
Fumigation.....	239	Purified talc.....	428
Isolation.....	239	Purity rubric.....	384
Quarantine.....	239	Putrefaction.....	167
Renovation.....	239	Pyogenic bacteria.....	167
Report of a disease.....	239	Pyrethrum.....	273
Susceptibles.....	239	Quarantine.....	239
Primary:		Lepers.....	275
Hæmorrhage.....	64	Maritime.....	274
Stage, syphilis.....	333	Quartz lamp, operation of.....	217
Procaine.....	476	Quicksilver.....	434
Use as anæsthetic.....	190	Quinine:	
Proctocolysis.....	148	And urea hydrochloride.....	190, 191
Property:		Chlorhydrosulphate.....	471
Accountability.....	634	Hydrochloride.....	471
Care of.....	528	Sulphate.....	471
Medical Department:		Rabid animal wounds.....	69
Accounting and property office.....	634	Rabies.....	260
Survey of.....	634	Radiant heat and light.....	212
Transfer of.....	634	Baths.....	214
Patients', custody of.....	564	Deep therapy lamps.....	215
Transfer of.....	528	Heat applicators.....	215
Prophylactic-s.....	409	Ultra-violet rays.....	215
Measures, general.....	138	Radicle-s.....	367
Measures, personal.....	138	Carbonate.....	369
Station, shore patrol.....	537	Formula for.....	368
Treatment, venereal diseases.....	346	Radius.....	12
Prostate gland.....	43	Rain water.....	286
Prostatitis.....	328	Rating-s:	
Treatment of.....	332	Advancement in, forms for.....	648
Protectives.....	477	Civilian employees, commissary department, naval hospitals.....	650
Protein-s.....	223	Enlisted personnel.....	593
Metabolism of.....	223	Ration memoranda.....	678
Products from animal substances and insects.....	465	Rats, extermination of.....	273
Sources of.....	223	Reactions, chemical.....	363
		Réaumur scale.....	390

	Page.		Page.
Recipes:		Renal depressants	409
Beef juice.....	234	Rennin	36
Chocolate—		Renovation	239
Shake.....	233	Reports:	
Syrup.....	233	And returns.....	637
Cocoa.....	232	Annual.....	649
Junket.....	235	Daily.....	649
Coffee.....	233	Hospital Corps forms.....	637
Custard.....	234	Monthly.....	649
Egg-s.....	233, 234	Quarterly.....	649
Nog.....	232	Sanitary.....	582
Milk—		Semi-annual.....	649
Malted, chocolate or cocoa.....	233	Weekly.....	649
Peptonized.....	232	When necessary.....	650
Orangeade.....	232	1st. and 16th. of month.....	649
Orange jelly.....	235	15th. of month.....	649
Tea, beef, with hydrochloric acid.....	234	28th. of month.....	649
Receptors	509	N. M. S. H. 38.....	676
Recruiting stations, complement of.....	575	Preparation of form—	
Rectified oil of tar.....	454	F.....	529
Rectifier, X-ray.....	546	K.....	529
Red:		Requisition-s:	
Cells.....	20	Headstones.....	648
Cinchona.....	470	On supply depots.....	629
Reducing agents.....	375	Open purchase.....	629
Reduction.....	375	Stub.....	629, 631
By traction or extension, shoulder dislocation.....	75	Resin-s	400, 457
Reflex action.....	48	Jalap.....	464
Refrigerants.....	409	Podophyllum.....	464
Refuse:		Scammony.....	464
Ashore.....	295	Resorcin	447
Disposal of.....	295	Respiration	123
Dry rubbish.....	295	Apnoea.....	32
Garbage.....	295	Asphyxia.....	32
Manure.....	296	Cycle of.....	31
Ships.....	295	Dyspnoea.....	32
Regimental:		Types of.....	32
Medical detachment—		Respiratory:	
Ambulance company.....	542	Depressants.....	409
Collecting stations.....	542	Stimulants.....	409
Field medical supply depot.....	544	System:	
Hospital company.....	543	Bronchi.....	30
Organization of.....	542	Larynx.....	30
Sanitary company.....	542	Lungs.....	31
Service company.....	542	Nasal chambers.....	30
Surgeon, expeditionary force.....	540	Organs of.....	30
Register, accounting system:		Pharynx.....	30
Charge.....	636	Pleura.....	31
Expense analysis.....	636	Trachea.....	30
Regular diet.....	232	Tract, diseases of.....	143
Regulations for mailing laboratory specimens.....	575	Restraining apparatus	137
Remains:		Resuscitation of apparently drowned	89
Forms for shipment of.....	648	Retina.....	50
Preparation of:		Rheostat, X-ray	547
Arterial injection, embalming.....	348	Rheumatic fever	146
Cavity injection, embalming.....	350	Rhizopoda.....	511
Fluid, embalming.....	350	Rhubarb, fluid extract of.....	465
Removal of foreign bodies	86	Rib-s	10
From ear.....	87	Fracture, symptoms and treatment.....	80
Eye.....	87	Rickets	285
Nose.....	87	Treatment by ultra-violet rays.....	217
Skin.....	88	Rigor mortis	16
Stomach and intestines.....	88	Roentgenography	549
Throat.....	88	Roentgenology. (See X-ray).	
		Roller bandages	99

	Page.		Page.
Roots and tubers for food.....	228	Sediment, definition of.....	393
Rotary convertor, X-ray.....	546	Sedimentation, water.....	288
Rotation, joint.....	15	Seminal vesicles.....	42
Rubber gloves, use in surgery.....	171	Senses, special.....	49
Rubefacients.....	131	Separation, fluids from solids.....	392
Sac, lachrymal.....	49	Sepsis.....	167
Saccharine and sugar substances.....	462	Septic:	
Salaries, Navy Department, appropriation.....	603	Sore throat.....	247
Salicylic acid.....	450	Tanks.....	293
Saline:		Septicæmia.....	143
Infusion.....	229	Sero-albumin.....	21
Irrigation.....	229	Serous membranes.....	18
Salivary glands, description of.....	33	Serum-s:	
Salol.....	450	Agglutinins.....	509, 510
Salt:		Amboceptors in.....	510
Normal solution.....	168	Anaphylaxis.....	508, 509
Physiological solution.....	190, 424	Antidiphtheritic.....	481
Use in food.....	223	Antigen.....	509
Salting and pickling of food.....	673	Antitoxins.....	509
Salts.....	371, 381	Bacteriolysins.....	509
Acid.....	371	Cytolysins.....	509
Alkaloidal.....	467	Fixation of complement.....	510
Basic.....	371	Immune.....	508
Double.....	371	Opsonins.....	509
Normal.....	371	Pneumococcus.....	509
Salvarsan.....	432	Precipitins.....	509
Sanitary:		Procuring of.....	632
Company, regimental medical detach- ment.....	542	Receptors.....	509
Devices, field—		Shock, anaphylactic.....	508, 509
Incinerators.....	314	Sickness.....	508
Latrines.....	314	Status lymphaticus.....	508
Urinals.....	314	Syphilis, diagnosis.....	510
Inspector, Marine Corps posts.....	540	Tetanus antitoxin.....	508
Investigations, on independent duty.....	526	Therapy.....	508
Reports.....	532	Immunity.....	508
Survey, shore patrol.....	538	Vaccination.....	510
Sanitation. (<i>See</i> Hygiene and sanitation.)		Vaccines.....	510
Field—		Service company, regimental medical detach- ment.....	542
Camp site, selection of.....	323	Sewage:	
Feet, care of.....	323	Digestion tanks.....	293
Insect control.....	318	Dilution.....	292
Marching.....	321	Disposal of.....	292
Value of.....	312	Dry system.....	295
Waste.....	313	Imhoff tanks.....	294
Collection.....	313	Purification.....	294
Disposal.....	313	Septic tanks.....	293
Water.....	312	Treatment.....	293
Santal, oil of.....	456	Water carriage system.....	292
Santonin.....	463	Sexual organs, male.....	326
Scapula.....	11	Shick test.....	507
Sarcophaga carnaria.....	520	Ships:	
Sarcoptes scabiei.....	517	Disposal of refuse on.....	295
Scarlet fever.....	140, 246	Fumigation of.....	271
Saturated solution.....	392	Ventilation—	
Sayre dressing.....	107	Artificial.....	279
Schaffer's method.....	89	Combined system.....	280
Schistosomes.....	513	Exhaust system.....	280
School, naval medical.....	607	Natural.....	279
Sclera.....	50	Plenum system.....	279
Scopolamine hydrobromide.....	474	Supply system.....	279
Scurvy.....	285	Shock.....	59
Secondary:		Anaphylactic serum.....	508, 509
Hæmorrhage.....	64	Electric.....	91
Stage, syphilis.....	333, 335	Symptoms of.....	50
Secretary of the Navy.....	583	Treatment of.....	60
Sedatives.....	407		

Shore patrol:	Page.	Sodium—Continued.	Page.
Dressing station.....	537	Salicylate.....	425
Duty with.....	533	Thiosulphate.....	425
Equipment for.....	536	Soft diet.....	231
Medical detachment.....	536	Solute.....	392
Prophylactic station.....	537	Solution-s:	
Sanitary survey.....	538	Chemical.....	392
Shoulder dislocation.....	74	Definition of.....	392
Kocher's method of reduction.....	75	Eyewash, filtration of.....	392
Reduction by traction or extension.....	75	Hypodermic.....	392
Stimson's method of reduction.....	74	Hypophysis.....	466
Sialogogues.....	409	Pharmaceutical.....	398
Sick call:		Saturated.....	392
Duties at.....	527	Simple.....	392
Ward.....	117	Solvents.....	392
Sick quarters, Marine Corps posts.....	540	Solvents.....	392
Siedlitz powder.....	420	Soporifics.....	409, 484
Silk clothing.....	297	Drug addiction.....	484
Silver:		Sore throat.....	98
Colloidal.....	438	Sores, bed.....	160
Compounds of.....	438	Special:	
Molded nitrate.....	438	Exigency public bills.....	632
Nitrate.....	438	Senses.....	48
Protein.....	438	Specialized cells.....	6
Silvol.....	438	Specific gravity:	
Simple:		Definition of.....	387
Syrup.....	398	Of urine.....	522
Solution.....	392	Specific volume, definition of.....	388
Sinusoidal current.....	219	Specifics.....	409
Siphonate mosquito.....	519	Speech, function of.....	52
Sippy diet.....	230	Spermatic artery.....	27
Sitz bath.....	160	Spinal:	
Skeleton:		Accessory nerves.....	47
Definition of.....	6	Anæsthesia.....	191
Divisions of.....	8	Cord.....	46
Skin.....	40	Nerves.....	47
Cuticle.....	40	Spine, fracture of.....	79
Dermis.....	40	Spirille.....	503
Description of.....	40	Spirit of nitrous ether.....	452
Diseases, treatment by ultraviolet rays.....	216	Spirits.....	398
Effects of ultraviolet rays on.....	216	Spleen, description of.....	37
Epidermis.....	40	Splints:	
Removal of foreign bodies from.....	88	Coaptation.....	78
Skull, treatment for fracture of.....	79	Materials used for.....	78
Sleep.....	52	Sponges, surgical dressings.....	170
Smallpox.....	140, 262	Sporozoa.....	512
Smears, blood work.....	504, 505	Sprain.....	72
Smell, sense of.....	51	Treatment of.....	72
Smoking of food.....	673	Squadron medical officer, duties of.....	530
Snake-s:		Squamous cells.....	6
Bites.....	69	Stains, bacteriological.....	503
Treatment of.....	70	Acid fast.....	504
Poisonous.....	520	Bismarck brown.....	503
Colubrine family.....	520	Carbolfuchsin.....	503
Viperine family.....	520	Eosin.....	503
Soap-s.....	403, 459	Gentian violet.....	503
Liniment.....	398, 461	Gram's.....	504
Soft.....	461	Hæmatoxylin.....	503
Sodium:		Methylene blue.....	503
Benzoate.....	421	Staphylococcus.....	167
Bicarbonate.....	422	Starch, corn.....	461
Borate.....	422	Starchy and mucilaginous substances.....	461
Bromide.....	423	Statement, expense analysis.....	636
Carbonate (monohydrated).....	423	Static electricity.....	221
Chloride.....	424	Stations, miscellaneous naval.....	596
Citrate.....	424	Statistical method, terms defined.....	299
Hydroxide.....	421		
Phosphate.....	425		

	Page.		Page.
Statistics, vital.....	299	Strychnine:	
Interpretation of.....	309	Poisoning by.....	495
Status lymphaticus.....	508	Sulphate.....	472
Steapsin.....	37	Stupes.....	131
Stenosis.....	24	Turpentine.....	131
Stereoscopic roentgenography.....	550	Styptics.....	409, 477
Sterilization.....	168	Subclavian vein.....	29
Alcohol.....	169	Subcutaneous:	
Asepsis in operating room.....	166	Administration of drugs.....	411
Autoclave.....	166, 168	Feeding.....	229
Bichloride of mercury.....	169	Injections.....	127
Boric-acid solution.....	169	Sublimation.....	390
Carbolic acid.....	169	Submarine bases.....	596
Chemical.....	169	Sucrose.....	462
Cocaine solution.....	190	Sudorifics.....	482
Dakin's solution.....	169	Suffocation.....	88
Equipment, Navy standard.....	165	Artificial respiration in.....	89
Formaldehyde.....	169	Choking, treatment for.....	90
Iodine.....	169	Hanging or strangling, treatment for.....	90
Iodoform.....	169	Poisonous gases.....	90
Irrigation of wounds.....	168	Resuscitation of apparently drowned.....	89
Mechanical.....	168	Schaffer's method.....	89
Media.....	503	Treatment for.....	89
Methods.....	168	Sugar:	
Operating-room linen.....	171	And saccharine substances.....	462
Potassium permanganate.....	169	Of lead.....	434
Room.....	165	Presence in urine.....	523
Thermal.....	168	Sulphonated oil.....	440
Water—		Sulphur:	
Chlorinated lime.....	290	Sublimed.....	415
Copper sulphate.....	290	Dioxide, disinfectant.....	268
Ozone.....	290	Sulphuric acid, graphic formula of.....	370
Ultra-violet rays.....	290	Poisoning by.....	496
Sterilized distilled water.....	414	Water mixed with.....	396
Sternum.....	10	Sunstroke.....	83
Sternutatory gases (sneeze gases):		Superior mesenteric artery.....	27
Di-phenyl-chlor arsine.....	557, 559	Supplies and Accounts, Bureau of.....	589
Di-phenyl-cyan arsine.....	557	Supplies, procuring of:	
Stimpson's method for reduction of dislocation.....	74	Alcohol.....	633
Stimulants.....	407, 481	Amboceptor paper.....	633
Stock:		Annual contract, Bureau of Yards and Docks.....	633
Card.....	678	Antigen.....	633
Ledger.....	636	Bacterial cultures, emulsions.....	633
Solution of mercuric chloride.....	392	Blood stain.....	633
Stomach:		Bottles and vials, for mailing.....	633
And intestines, removal of foreign bodies from.....	88	Culture media.....	633
Description of.....	33	Departmental contracts.....	633
Hæmorrhage from.....	64	Forms.....	633
Tube, use in poisoning.....	499	Mailing cases.....	633
Stomachics.....	409	Requisitions.....	628, 629
Stomoxys calcitrans.....	520	Serums.....	632
Storeroom:		Special.....	632
Commissary department, naval hospitals.		Transfer of labor from navy yard.....	633
Dry provision.....	651	Typhoid prophylactic.....	632
Issuing.....	651	Vaccines.....	632
Stores, care of.....	528	Supply table, classification of drugs on.....	477
Stovaine, use in anæsthesia.....	192	Suppository—ies.....	400
Strain.....	72	Rectal.....	151
Treatment of.....	72	Suppuration.....	167
Strategy, naval, defined.....	597	Suppurative tonsillitis.....	145
Streptococcus.....	167	Suprarenal-s:	
Strontium.....	427	Artery.....	27
Strophanthus.....	463	Dried.....	466
Tincture of.....	463	Glands.....	38
		Surface water.....	287

	Page.		Page.
Surgeons general.....	600	Tænia saginata.....	514
Surgery (<i>See</i> operating room and surgical technique).		Tænia solium.....	514
Surgical:		Tæniacides.....	409
Dressings.....	155	Talc, purified.....	428
Drainage material.....	171	Tannic acid.....	450
Forms of.....	170	Tape worms.....	513
Gauze dressings.....	170	Tapotement.....	194
Kinds of.....	156	Target, X-ray.....	545
Materials used.....	169	Tartaric acid.....	451
Packs.....	170	Taste:	
Procedure in applying.....	156	Buds.....	51
Sponges.....	170	Sense of.....	51
Strips.....	170	Teeth:	
Nursing.....	146	Cementum.....	110
Technique (<i>See</i> operating room and surgical technique).		Changes in structure.....	111
Survey:		Cleaning of.....	111
Medical department property.....	634	Crown.....	110
Medical, for drug addiction.....	487	Decay of.....	111
Suture-s.....	68, 172	Dental pulp.....	111
Needles for.....	68	Dentine.....	110
Removal from skin.....	156	Dental tubules.....	110
Sweat:		Divisions of.....	111
Characteristics of.....	39	Enamel.....	110
Glands.....	40	Filling, temporary.....	114
Sweet birch, oil of.....	455	Fundamental parts.....	110
Symbols, chemical.....	357	Neck.....	110
Sympathetic nervous system.....	43	Odontoblasts.....	110
Symptoms, poisoning.....	490	Peridental membrane.....	110
Table of.....	497	Pulp cavity.....	110
Syndesmology, definition of.....	6	Root.....	110
Synovial membrane.....	19	Structure of.....	110
Synthesis.....	354	Telegrams, forms of.....	649
Syphilis.....	259	Temperature:	
Arsphenamine.....	336	Of—	
Administration of.....	339	Patient.....	120
Chancre.....	334	Wards.....	118
Detection of, by serum reaction.....	506	Tenacity, definition of.....	355
Diagnosis of, by serum reaction.....	510	Terebene.....	457
Infection, sources of.....	334	Terminal disinfection.....	239
Initial lesion.....	334	Ternary compounds.....	361
Mercury—		Terpin hydrate.....	457
Intramuscular injection.....	342	Tertiary stage, syphilis.....	334, 335
Inunction.....	342	Testes.....	42
Neocarphenamine.....	340	Testicles.....	42
Administration of.....	342	Tetanus.....	143, 264
Stage:		Antitoxin serum.....	508
Primary.....	333	Theoretical pharmacy.....	383
Secondary.....	333, 335	Therapeutic-s:	
Tertiary.....	334, 335	Definition of.....	407
Treatment of.....	336, 481	Incompatibility.....	405
Treponema pallidum.....	333, 334, 344	Therapy, X-ray:	
Syrups.....	398	Deep.....	552
Glucose.....	399	Electric current dangers.....	553
Iodide of iron.....	398	Erythema dose.....	552
Ipecac, glycerin used in.....	399	Superficial.....	552
Simple.....	398	Thermometer:	
Systemic veins.....	28	Clinical.....	120
Table:		Scales used in marking.....	390
Of inorganic acids.....	381	Thoracic duct.....	29
Atomic weights.....	379	Thorax.....	10
Measures.....	385	Throat, removal of foreign bodies from.....	88
Weights.....	385	Thrombin.....	22
X-ray.....	548	Thymol.....	455
Tactics, naval, defined.....	597	Iodide.....	455
		Thymus gland.....	38
		Thyroid gland.....	38
		Tibia, description of.....	14

	Page.		Page.
Ticks.....	518	Tuberculosis.....	144
Tincture-s.....	399	Diet in.....	231
Aconite.....	474	Other than pulmonary.....	248
Camphorated opium.....	469	Pulmonary.....	248
Capsicum.....	456	Treatment by ultra-violet rays.....	216
Cinchona, compound.....	470	Tubes, X-ray:	
Digitalis.....	463	Coolidge.....	545
Gentian, compound.....	464	Gas.....	545
Iodine.....	399, 413	Terminals—	
Potassium iodide used in.....	399	Anode.....	545
Myrrh.....	458	Cathode.....	545
Nux vomica.....	473	Turpentine:	
Opium.....	469	Oil of.....	457
Strophanthus.....	463	Stupes.....	131
Tissue-s:		Type processes.....	397
Adipose.....	6	Typhoid:	
Areolar.....	6	Fever.....	141, 253
Cartilaginous.....	6	Prophylactic, procuring of.....	632
Connective.....	6	Typhus.....	143
Epithelial.....	6	Fever.....	256
Fiber.....	6	Ulcer, perforated, gastric or duodenal.....	95
Fibrous.....	6	Ulna.....	12
Fluid.....	6	Ultra-violet rays:	
Lymphoid.....	6	Mercury vapor arc lamp.....	217
Muscle.....	15	Quartz lamp, operation of.....	217
Muscular.....	6	Rickets, treatment by.....	217
Nervous.....	6	Skin—	
Osseous.....	6	Diseases, treatment by.....	216
Varieties of.....	6	Effect on.....	216
Titration.....	377, 378	Sources of.....	216
Tongue, description of.....	33	Sterilization of water by.....	290
Tonicity, muscle.....	16	Tuberculosis, treatment by.....	216
Tonics.....	409	Wounds, treatment by.....	217
Tonsillitis, follicular.....	145	Unconsciousness.....	90
Torpedo stations, naval.....	596	Caused by alcoholism.....	93
Torrefaction.....	390	Hysterical.....	92
Torsion balance.....	387	Unsaponifiable fats.....	403
Tourniquet, use of.....	62	Uræmia.....	92
Toxicology.....	489	Ureters.....	41
Definition of.....	383, 489	Urethra.....	42
Poison.....	489	Urinalysis.....	522
Toxins.....	507	And blood chemistry.....	521
Food.....	284	Urinary:	
Trachea.....	30	Bladder.....	42
Trachoma.....	264	System.....	40
Training stations, naval.....	596	Kidneys.....	40
Transfer:		Organs of.....	40
Medical department property.....	634	Ureters.....	41
Patients, to special hospitals, forms for.....	648	Urethra.....	42
Transformer, X-ray.....	546	Urinary bladder.....	42
Trematodes.....	513	Urine:	
Treponema pallidum.....	333, 334, 344, 506	Albumin, presence in.....	523
Trichinella spiralis.....	516	Characteristics of.....	39
Trichinosis.....	261	Color.....	522
Trichiuris trichiura.....	516	Composition of.....	522
Tricresol.....	447	Description of.....	522
Trigeminal nerves.....	47	Examination before operation.....	148
Trinitrophenol.....	447	Examination of.....	522
Trinitrotoluene poisoning.....	496	For examination.....	522
Trituration.....	391	Microscopical examination of.....	524
Trochlear nerve.....	47	Odor.....	522
Tropococaine, use in anesthesia.....	192	Reaction.....	522
Trypanosoma gambiense.....	511	Specific gravity.....	522
Trypsin.....	37	Sugar, presence in.....	523
		Transparency.....	522

	Page.		Page.
Uratropine.....	445	Vermicides.....	409
Vaccination.....	510	Vermifuges.....	409
Smallpox, methods of.....	262	Vermín, destruction of.....	273
Vaccine-s:.....		Vertebræ.....	10
Autogenous.....	510	Vertebral column.....	10
Bacterial.....	510	Vesical:.....	
Procuring of.....	632	Sedatives.....	410
Stock.....	510	Tonics.....	410
Vacuum electrode treatments.....	221	Vesicant-s.....	131
Valence.....	358	Gases, poison:.....	
Valuables, patients'.....	565	Lewissite.....	557
Valves, heart.....	24	Mustard.....	557, 560
Vaporization.....	390	Vincent's angina.....	114, 145
Vascular system.....	19	Vinegars.....	396
Organs of.....	23	Viscera, animal, for food.....	227
Veal:.....		Vital statistics. (<i>See</i> Statistics.).....	
As food.....	227	Vitamines.....	285
Cuts of.....	664	In foods.....	226
Vegetable:.....		Vitreous body.....	50
Drugs containing cathartic principles... ..	464	Volatile oils.....	403, 452
Foods.....	228	Volume. (<i>See</i> Specific):.....	
Vein-s:.....		Volumetric solutions.....	377
Description of.....	25, 28	Normal.....	378
Division of.....	28	Double.....	378
Forearm and arm.....	29	Hundredth.....	378
Innominate.....	29	Tenth.....	378
Jugular.....	29	Wards:.....	
Mesenteric.....	29	Care and cleaning of.....	118
Neck, great superficial.....	29	Cleaning material.....	118
Portal system.....	29	Cleanliness of.....	118
Pulmonary.....	28	Daily routine duties in.....	117
Subclavian.....	29	Lighting of.....	283
Systemic.....	28	Management and general supervision of..	116
Vena azygos.....	29	Patients, admission of.....	116
Venæ cavæ.....	29	Sick call.....	117
Velpeau bandage.....	105	Temperature of.....	118
Vena azygos.....	29	Venereal.....	116
Venæ cavæ.....	29	Ventilation of.....	118
Venereal:.....		Warrant officers.....	592
Diseases.....	324	Water-s.....	396, 414
Balanitis.....	331	Ammonia.....	396
Chancroid.....	343	Stronger.....	426
Effects of.....	324	Analysis, sanitary.....	288
Epididymitis.....	331	Artesian wells.....	287
Examination of crew.....	531	Borne diseases.....	141
Gonorrhœa.....	326	Chlorination of.....	291
Symptoms of.....	327	Definition of.....	414
Gonorrhœal ophthalmia.....	332	Distilled.....	287, 414
Herpes.....	346	Field sanitation—.....	
Paraphimosis.....	331	Canteens, care of.....	313
Phimosis.....	331	Chlorination.....	313
Prevention of.....	346	Daily allowance.....	312
Prophylactic treatments.....	346	Purification.....	313
Prostatitis.....	332	Source.....	312
Syphilis.....	333	Storage, collection, and distribution..	313
Venereal warts.....	345	Filters.....	290
Treatment of.....	345	Filtration, sand.....	290
Wards.....	116	Ground.....	287
Venous hæmorrhage.....	61	Of crystallization.....	394
Ventilation:.....		Official, manufacture of.....	393
Artificial, on shore.....	279	Purification of.....	288
Definition of.....	278	Rain.....	286
Natural, ashore.....	279	Relation to health and disease.....	286
Of houses.....	279	Sedimentation.....	288
Of operating room.....	164	Shallow wells.....	287
Of wards.....	118	Source of supply.....	286
Of ships.....	279		
Test for.....	280		

Water-s—Continued.	Page.	Wound-s—Continued.	Page.
Sterilization.....	290	Healing:	
Sterilized, distilled.....	414	First intention.....	65
Sulphuric acid, mixed with.....	396	Second intention.....	65
Supply, on march and in camp.....	290	Incised.....	64
Surface.....	287	Infected or septic.....	64
Wax, white.....	460	Insect bites.....	70
Weighing, definition of.....	385	Lacerated.....	64
Weight-s:		Penetrating, chest.....	71
Atomic.....	356	Poisoned.....	64
Table of.....	379	Poisoning:	
Definition of.....	385	Colubrine snake.....	70
Molecular.....	357	Viperine snake.....	70
Table of.....	385	Poisonous.....	69
Wells:		Punctured.....	65
Artesian.....	287	Snake bites.....	69
Shallow.....	287	Sutures.....	68
Wet:		Treatment—	
Dressings.....	133	By ultra-violet rays.....	217
Pack.....	208	General principles.....	65, 67
Whooping cough.....	249	Xerophthalmia.....	285
Wild cherry, fluidextract of.....	456	X-ray:	
Wintergreen, oil of.....	455	Accessories.....	551
Wool clothing.....	297	Cassette.....	551
Worms:		Characteristics of.....	545
<i>Ascaris lumbricoides</i>	515	Dangers from.....	553
Cestodes.....	513	Dark room.....	550
<i>Clonorchis endemicus</i>	513	Definition of.....	544
<i>Fasciolopsis buski</i>	513	Fluoroscopy.....	549
<i>Filaria bancrofti</i>	516	Intensifying screens.....	551
Flat.....	513	Machine.....	545
Flukes.....	513	Autotransformer.....	547
Hookworms.....	515	Control apparatus.....	547
<i>Hymenolepis nana</i>	514	Filament circuit.....	548
<i>Nemathelminthes</i>	514	Motor.....	546
<i>Oxyuris vermicularis</i>	516	Rheostat.....	547
<i>Paragonimus westermanni</i>	513	Rotary converter.....	546
Pin or seat.....	516	Transformer.....	546
Round.....	514	Wiring, overhead.....	547
Schistosomes.....	513	Physics.....	544
<i>Tænia saginata</i>	514	Roentgenography.....	549
<i>Tænia solium</i>	514	Stereoscopic.....	550
Tape.....	513	Table.....	548
Trematodes.....	513	Therapy.....	552
<i>Trichinella spiralis</i>	516	Tubes.....	545
<i>Trichuris trichiura</i>	516	Xylol bromide gas.....	557, 559
Wound-s.....	64	Yards and Docks, Bureau of.....	586
Abdominal.....	71	Yellow:	
Aërobic bacteria present in.....	65	Fever.....	142, 257
Anaërobic bacteria present in.....	65	Wax.....	401
Clean or aseptic.....	64	Young's rule.....	410
Contused.....	64	Zinc:	
Crushing.....	65	Compounds of.....	429
Eye.....	71	Oxide.....	429
From rabid animal.....	69	Sulphate.....	430
Gunshot.....	65, 71	Zingiberis, fluidextract of.....	454
		Zoology, definition of.....	383

ADDITIONAL COPIES

OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.

AT

\$1.00 PER COPY

PURCHASER AGREES NOT TO RESELL OR DISTRIBUTE THIS
COPY FOR PROFIT.—PUB. RES. 57, APPROVED MAY 11, 1922



VG 460 qU582h 1923

14410630R



NLM 05101395 4

NATIONAL LIBRARY OF MEDICINE